REPORT ON THE REMEDIAL INVESTIGATION OF THE ROSE CHEMICALS SITE HOLDEN, MISSOURI

APPENDIX D - SUBSURFACE EXPLORATION TECHNICAL MEMORANDUM

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PART I

INTRODUCTION

Exterior subsurface investigation at the Rose Chemicals Site (Site) consisted of the drilling and installation of 8 nests of two (2) groundwater monitoring wells each (see Figure I-1) and the excavation of 11 test pits (see Figure I-2). Each nest consisted of a shallow monitoring well advanced to auger refusal at depths of 5 to 16 feet, and a deep monitoring well drilled to a depth of 50 feet or to a minimum of 40 feet penetration into the bedrock, whichever was less. The monitoring wells are designated with the prefix MW. Those with designated numbers in the 100s are the deep monitoring wells drilled into the bedrock, and those with designated numbers in the 200s are the shallow monitoring wells drilled to the top of bedrock only. Three rounds of groundwater sampling were conducted after development of the monitoring wells.

Exterior subsurface investigation activities were performed as outlined in the Sampling and Analysis Plan, Rose Chemicals Site, Holden, Missouri, Burns & McDonnell Engineering Company, January 1989 (SAP). Additional subsurface investigation activities were performed at the Site as outlined in Addendum No. 1 to the Sampling and Analysis Plan, Rose Chemicals Site, Holden, Missouri, Burns & McDonnell Engineering Company, July 1989.

MW-101, MW-102, MW-103, MW-201, MW-202, and MW-203 were drilled and installed by John Mathes & Associates, Columbia, Illinois. Information about these monitoring wells is taken from Rose Chemical Project, Holden, Missouri Site

Investigation, Preliminary Site Assessment Report, John Mathes and Associates, July 31, 1987. MW-104 through MW-111 and MW-204 through MW-211 were drilled and installed by Layne-Western Company under the direction of Burns & McDonnell Engineering.

Soil samples and rock cores from MW-104 through MW-111 were inspected, geologically logged, and sampled by a Burns & McDonnell geologist. Continuous soil sampling by split-spoon samplers or Shelby tubes was performed until bedrock was encountered. Soil samples were obtained for analysis of the contaminants of concern which are polychlorinated biphenyls (PCBs), volatile organic compounds (VOCs), and semivolatile organic compounds (SVOCs). Engineering properties of the soil samples were also evaluated. Bedrock was cored and geologically logged to a depth of approximately 50 feet in each of the boreholes for the deep monitoring wells. In addition, prior to well placement the boreholes of MW-104, MW-107, and MW-110, were packer tested to determine the in-situ hydraulic conductivity of selected bedrock layers. An in-situ hydraulic conductivity test (slug test) also was conducted on MW-104 after its development. The slug test consisted of removing a known volume of water from the monitoring well and measuring the groundwater recharge rate into the monitoring well. The slug test was performed and calculated according to procedures described by Hvorslev (U.S. Army Corps of Engineers Bulletin No. 36, 1951).

Soil samples from the adjacent shallow borehole of each nest were not taken; however, soil from these wells was visually inspected and geologically logged in the field by a Burns & McDonnell geologist. Slug tests were conducted on MW-205, MW-206, and MW-210.

Eleven test pits were excavated adjacent to and beneath the on-site sanitary and storm sewers at the Site. The test pits were excavated with a backhoe to sewer invert elevation. At each test pit, a soil sample was taken from underneath the sewer at sewer invert elevation and analyzed for PCBs, VOCs, and SVOCs. The test pits were backfilled with clean gravel from an off-site source upon completion.

Drilling and test pit logs were prepared in the field by a Burns & McDonnell geologist. Information obtained during the drilling and test pit excavation will be used to further define: (1) stratigraphy of the subsurface units, (2) physical and engineering properties of the soil and bedrock, (3) presence of contamination in the subsurface, and if present (4) the type and approximate extent of the contamination.

The Site Health and Safety Plan, Rose Chemicals Site, Holden, Missouri, Burns & McDonnell Engineering Company, January 1989, was followed at all times. Level C personal protective equipment was initially worn for exterior subsurface investigation activities. However, based upon TIP Photoionizer and HNu Model PI101 readings, exterior subsurface investigation activities were downgraded to modified level D personal protective equipment.

The purpose of this technical memorandum is to document the field activities performed during the Remedial Investigation (RI) subsurface investigation. Procedures for the drilling and installation of the monitoring wells and the excavation of the sewer sampling test pits are presented. Geology and hydrogeology of the soil and bedrock is presented in Part IV. Drilling logs for

all monitoring well boreholes drilled during the RI subsurface investigations are included in Appendix A of this report. Appendix B is a record of observed water level readings of the monitoring wells. Appendix C contains a record of observed pH values for the monitoring wells. The logs of five test pits are in Appendix D. Appendix E contains the laboratory report from Kansas City Testing Laboratory. Appendix F contains the drilling logs and well construction records for the previously installed groundwater monitoring wells. Other figures provided in this report (following the text) include geologic profiles constructed using data from the drilling logs of the deep boreholes, monitoring well construction records for both the shallow and deep monitoring wells, a shallow groundwater gradient map, a deep groundwater gradient map, profile views of five test pits, a top of rock contour map, a stratigraphic column, and a net soil thickness map.

PART II

MONITORING WELLS

A. GENERAL

Drilling of the boreholes and installation of the monitoring wells were completed by the Layne-Western Company, Kansas City, Kansas. A Burns & McDonnell geologist continuously observed these activities. During drilling the geologist also performed air monitoring and prepared drilling logs.

1. AIR MONITORING

Air in the vicinity of drilling operations, both within the borehole and in the worker breathing zone, was monitored with a Photovac T.I.P. II (TIP) photoionization detector (10.2-eV lamp) or an HNU photoionization detector to assess levels of VOCs. In addition, all soil samples were screened in the field with the TIP to detect the presence of VOCs. TIP or HNU readings were recorded in the field logbooks and on the drilling logs.

2. DRILLING LOGS

The drilling logs for the boreholes were prepared in the field by a Burns & McDonnell geologist through observation of the drilling operations, and the examination and classification of soil and rock samples. The deep boreholes were drilled, sampled, and geologically logged. The adjacent-shallow borehole in each nested pair was not sampled, but was logged by a Burns & McDonnell geologist based on visual

inspection of drill cuttings. The logs for the boreholes drilled during the RI are included as Appendix A to this memorandum. The drilling logs for the previously installed monitoring wells are contained in Appendix F. The logs were used to produce the geologic profiles shown in Figures II-1 through II-4. The profile locations are shown on Figure I-1. The logs will be used throughout the RI activities to prepare the geologic and hydrogeologic model of the Site.

B. DEEP MONITORING WELLS

1. SOIL BORING

The deep boreholes were advanced to auger refusal (approximately top of bedrock) using 6-inch diameter hollow stem augers (Figure II-5, Step 1). Split-spoon and Shelby tube samples were obtained during the augering phase. To prevent cross-contamination between the overburden soil and the bedrock, an uncapped 4-inch diameter steel surface casing was set and grouted into the bedrock with a bentonite cement grout (Figure II-5, Step 2), at depths ranging from 0.7 to 6.0 feet below the top of rock. The grout filled the cavity between the casing and the borehole. The borehole was left undisturbed for a period of at least 24 hours to allow the grout to set up.

After curing, the grout inside the bottom of the surface casing and below the surface casing was then drilled out using rotary wash drilling techniques with a tri-cone bit (Figure II-5, Step 3). At this point the

borehole was prepared for bedrock coring which is discussed in a succeeding section.

2. SOIL SAMPLING

Continuous subsurface soil samples were obtained from ground surface to the top of bedrock in each of the deep boreholes, using standard penetration test split-spoon samplers according to ASTM D1586 or 3-inch diameter Shelby tubes according to ASTM D1587.

A total of 50 soil samples of various lengths (see Table II-1), were taken from the deep boreholes. Portions of 17 of these samples were selected for chemical analyses for PCBs, VOCs, and SVOCs. In accordance with the SAP, two soil samples were selected for chemical analyses from each deep borehole, except for MW-106 where three soil samples were selected for analysis due to the small quantities of the recovered samples. Also, in accordance with the SAP, replicate samples were prepared and analyzed. The sample matrix identifying all sample locations and the samples selected for laboratory analysis is presented in Table II-1.

All soil samples slated for chemical analysis were placed in pre-cleaned sample jars provided by EMS Laboratories, Inc., Kansas City, Missouri. A subsample of each soil sample collected was stored in a separate glass jar for possible subsequent testing for engineering properties of percent moisture, Atterberg limits, and hydrometer analysis. A total of six soil samples were selected to be tested by Kansas City Testing

Laboratory. The sample matrix identifying the samples selected for laboratory analysis is presented in Table II-1. Samples were selected only if the corresponding chemical analyses showed low to "below detection limit" concentrations for the target compounds.

One Shelby tube sample each from boreholes for MW-105, MW-106, MW-107, and MW-110 was obtained. In accordance with the SAP, the samples from MW-105, MW-106 and MW-110 were submitted to Kansas City Testing Laboratory for laboratory determination of soil permeability. The Shelby tube sample from MW-107 was retained for possible subsequent testing, if required. The laboratory permeability determinations utilized the U.S. Army Corps of Engineers method contained in EM-1110-2-1906, Appendix VII (permeability calculated from consolidation test data).

Replicate samples were taken from boreholes for MW-106 and MW-111. To collect these samples the long cylindrical sample which results from a split-barrel sampler was split longitudinally with a decontaminated knife. One split half of the long cylindrical sample was used to fill the sample jars for the test sample and the second split half was used to fill the replicate sample jars. Thus, relatively equivalent samples for both the test and replicate sample were obtained. In the case of the borehole for MW-106, the volume from a single split-barrel sampler (SS-4) was insufficient to complete the replicate sample portion, so soil from the next lower split-barrel sample (SS-5) was used.

The test and replicate samples were placed in separate sample containers. The sample containers were placed on ice in coolers and delivered to EMS Laboratories daily. The replicates were identified with unique sample identification numbers and the sample station where the replicate was collected was documented in the field logbook.

All samples, sampling tools, and sample jars were handled with clean, disposable gloves. New clean gloves were worn for handling each sample. The soil samples were removed from the samplers using a clean stainless steel sample knife. All samples were collected to minimize sampling error and bias.

3. ROCK CORING

Bedrock was cored continuously from the top of bedrock to a depth of 50 feet or to a total depth of 40 feet of bedrock whichever was less (Figure II-5, Step 3). A standard NX-size (3-inch outside diameter) core bit and core barrel was used. The rock cores were 2-1/8-inch in diameter and generally obtained in 5- to 10-foot lifts (or "runs") as noted in the drilling logs.

Each core was geologically logged in the field. The cores were logged by Burns & McDonnell geologists noting rock type, color, weathering, strength, structures, and intervals where the rock was not recovered, as appropriate. This information was recorded on the drilling logs in the description column. The length of each individual core segment was recorded in the "Blow Count" column of the logs. After a core was

logged, it was sealed in plastic bags and placed in core boxes. The core boxes were temporarily stored in the on-site trailer prior to transfer to a permanent Burns & McDonnell storage area.

4. DRILLING WATER

Water from the Holden potable water supply was used for bedrock drilling activities. No other drilling fluids or additives were used. Prior to use in drilling, two samples from the Holden water supply were tested for the RI constituents of concern. One sample showed no target compounds at detectable limits, and the other contained three trihalomethanes at levels characteristic of chlorinated potable water supplies. The water was used to remove the cuttings by pumping the water down through the drill rods and bit and then up the annulus between the borehole wall and the drill rods. Once at the surface, the cuttings were allowed to settle out and the water was recirculated back to the hole to minimize the quantity of water used. A new supply of Holden city water was used at each location. All water used for drilling activities was collected for treatment as discussed in Part VI.

5. IN-SITU HYDRAULIC CONDUCTIVITY MEASUREMENTS - PACKER TESTS

After completion of the rock coring (Figure II-5, Step 3) and prior to the construction of MW-104, MW-107, and MW-110, the boreholes for these wells were packer tested to determine the in-situ hydraulic conductivity of selected bedrock strata. Prior to packer testing the monitoring well boreholes were flushed with fresh water until the return water was

visually clean. Selected strata within the monitoring well borehole were sealed off with the packer assembly and tested. The packer tests were conducted using 3-inch expandable rubber packers run in on 1-inch tubing to the selected depth intervals as indicated in Table II-2. The packers were placed to isolate an interval ranging from 2 to 7 feet in length. The packers were expanded using pressurized nitrogen gas to hold them in position against the cored rock surface. Once positioned and secured in place, pressure was applied to the isolated zone by pumping Holden city water through the 1-inch tubing supporting the packer assembly into the test zone at 0.8 psi per foot of overburden. The packer tests were run from 2 to 3 hours. The results of the packer testing are shown in Table II-2. Of the ten intervals tested, seven accepted no flow and the highest calculated hydraulic conductivity was 6×10^{-6} cm/sec.

6. WELL INSTALLATION

Upon completion of coring and packer testing, the portion of each borehole which extended into bedrock was grouted with a cement/bentonite slurry (Figure II-5, Step 4) and allowed to cure for a minimum of 24 hours. The grouted portions of the boreholes were then enlarged to approximately 4 inches in diameter using rotary wash techniques (Figure II-5, Step 5). The boreholes were enlarged to the depths designated for the bottom of each well screen. The packer test results had indicated there were no highly permeable intervals; hence, the monitoring well screens were set to allow evaluation of the groundwater flow characteristics and groundwater quality of the different strata. Table

II-3 presents the packer test intervals and the monitoring well screens set in the intervals. The placement of the screens in relationship to the bedrock strata is shown in Figures II-1 to II-4.

In each borehole, 2-inch I.D., Schedule 80, flush-threaded PVC casing and machine-slotted screen with 0.010-inch slots were installed (Figure II-5, Step 6). All screens were 5 feet in length. The annular space between the screen and the borehole wall was backfilled with bagged, well-graded (no fines), silica sand to approximately 2 to 3 feet above the top of the well screen (Figure II-5, Step 7). A 2-foot thick bentonite pellet seal was then placed above the silica sand (Figure II-5, Step 7). The monitoring well was left undisturbed for a minimum of 24 hours to allow hydration of the bentonite.

The remaining annular space was then grouted to the ground surface with bentonite/cement grout (Figure II-5, Step 8). A 6-inch square steel locking protective cover was grouted in place. Identical locks were put on all the monitoring wells. A survey was conducted to determine the elevations of the top of casing and the ground surface of each deep monitoring well. The elevations were noted on the water level monitoring records. Well construction records for the deep monitoring wells are included as Figures II-6 through II-13. Appendix F shows the construction records for the deep wells installed previously.

7. IN-SITU HYDRAULIC CONDUCTIVITY MEASUREMENT - SLUG TEST

After the deep monitoring wells were completely installed, a slug test was performed on MW-104 to document that in-situ hydraulic conductivity was not significantly different before and after well installation. MW-104 was selected because it had been packer tested over the depth interval of 42 to 46 feet and it was subsequently screened during well installation over essentially the same depth interval - 41 to 46 feet.

The slug test consisted of removing a known amount of water (a slug) and measuring the groundwater recharge rate into the monitoring well. For this slug test an SE1000B environmental logger was used to measure the recharge rate over a 24-hour period. The slug test was performed and calculated according to procedures described by Hvorslev (U.S. Army Corps of Engineers Bulletin No. 36, 1951). The resulting hydraulic conductivity of 2.5×10^{-6} cm/sec was similar to that exhibited during the packer test (1×10^{-6} cm/sec).

Water level measurements were obtained over a period of over six months after installation of the monitoring wells. The data thus obtained, as the levels were allowed to recover and approach a static water level, were used as slug test data. Using this data, hydraulic conductivities were computed according to the method described by Hvorslev (1951), for Monitoring Wells MW-101, MW-103, MW-106 and MW-109. The values thus obtained are as follows:

Monitoring Well	Hydraulic Conductivity (cm/sec)
MW-101	7.0×10^{-9}
MW-103	1.7×10^{-8}
MW-106	1.3×10^{-8}
MW-109	2.5×10^{-8}

These hydraulic conductivity values, as well as other hydraulic conductivity values calculated for this project, are shown on Figures II-1 through II-4.

C. SHALLOW MONITORING WELLS

1. SOIL BORING

The shallow boreholes were augered to refusal in bedrock with 6-inch diameter hollow stem augers. The total depths of the shallow boreholes varied from 5 to 16 feet.

2. WELL INSTALLATION

The monitoring wells were constructed using 2-inch diameter, Schedule 80, flush-threaded PVC casing and machine-slotted screen with 0.010-inch slots. The screens of the shallow monitoring wells were set at the bottom of the boreholes since no free water was encountered during drilling. Five feet of screen was set in all of the shallow monitoring wells except for MW-204 in which only 2 feet of screen was set due to the shallow depth of the borehole. The annular space was backfilled with washed silica sand to approximately 1 to 2 feet above the top of the screen. Above the sand, a bentonite pellet seal 1/2-foot to 2-1/2 feet thick was placed in the annular space. The monitoring

well was left undisturbed for a minimum of 1-1/2 hours to allow hydration of the bentonite to form a seal in the annular space. Visual inspection determined that hydration of the bentonite pellets had occurred. The remaining annular space was then grouted to the ground surface with cement/bentonite grout. A 4-inch square steel locking protective cover was then grouted in place. All the monitoring wells were locked with identical locks. A survey was conducted to determine the elevations of the top of casing and the ground surface of each shallow monitoring well. The elevations were noted on the water level monitoring records. Details of the construction of MW-204 to MW-211 can be seen in Figures II-14 to II-21. The well construction records for the shallow wells installed previously are in Appendix F to this memorandum.

3. IN-SITU HYDRAULIC CONDUCTIVITY MEASUREMENTS - SLUG TESTS

In-situ hydraulic conductivity tests (slug tests) were conducted on MW-205, MW-206, and MW-210 after their development. The slug tests consisted of removing a known volume of water from the monitoring well and measuring the groundwater recharge rate into the monitoring well. The slug tests were performed and calculated according to procedures described by Hvorslev (U.S. Army Corps of Engineers Bulletin No. 36, 1951).

The shallow monitoring wells have screens set into the bedrock/soil interface. It should be noted that in several instances the soil auger penetrated the uppermost, weathered bedrock. In these locations the

shallow well screens may be placed partially in the weathered shales, most of the characteristics of which are similar to the overlying clay soil. The hydraulic conductivities measured for the three shallow monitoring wells are:

MW-205	1.6×10^{-5} cm/sec
MW-206	4.4×10^{-5} cm/sec
MW-210	1.5×10^{-5} cm/sec

As with the deep wells, water level measurements over time were used as slug test data for two shallow wells. The following hydraulic conductivity valves were calculated using the method described by Hvorslev (1951) for Monitoring Wells MW-206 and MW-210:

MW-206	7.6×10^{-5} cm/sec
MW-210	5.5×10^{-5} cm/sec

D. WATER LEVEL MONITORING

Water levels were taken at the Site after the wells had been installed, during well development, during groundwater sampling rounds and for a period exceeding six months after installation. Water levels were taken in accordance with the procedure presented in the SAP. Several sets of groundwater level measurements were taken to help in determining the groundwater model for the site. Observed water level readings are found in Appendix B. A shallow groundwater gradient map for April 5, 1989 is presented in Figure II-22.

Water levels for all of the monitoring wells for October 2, 1989 can be found on Figures II-1 through II-4.

The previously installed deep wells were screened across several strata, and the newly installed deep wells were screened over a specific stratum with a maximum of three screens in any one stratum. It is not possible to prepare a groundwater gradient map for specific deep strata except for the lower sandstone unit. MW-104, MW-108 and MW-111 were screened in the lower sandstone unit. In addition, the previously installed MW-101 and MW-103 are at least partially screened in the Labette Formation. From groundwater measurements a groundwater gradient of 1 percent to the northwest can be calculated. A deep groundwater gradient map for the sandstone for October 2, 1989 is presented in Figure II-23.

E. WELL DEVELOPMENT

A Burns & McDonnell geologist supervised monitoring well development activities. These consisted of:

- o bailing water from the wells,
- o measuring pH and conductivity frequently, and
- o logging water levels.

All monitoring well development fluids were treated as described in Part VI.

A record of pH readings over time for each of the monitoring wells is contained in Appendix C. These records show that all deep monitoring wells except MW-101, MW-102, and MW-106 showed high pH readings above 9.00 after the initial bailing of water to develop the wells. Since one of the wells (MW-103) exhibiting high pH readings was a previously installed well, it was

initially thought that the deep groundwater might naturally occur at high pHs due to some phenomenon related to the low hydraulic conductivity exhibited by the rock strata. However, with additional bailing the pH levels in most wells began to decrease slowly.

Near the end of February, 1989, it was decided to proceed with the first round of groundwater sampling. Except for MW-107 and MW-109, the pH of the wells had fallen below 10 and appeared to be stabilizing. MW-107 and MW-109 recharged so slowly that even obtaining a sample from these wells remained in question. In fact, for the first sampling round the quantity of water available in MW-107 provided only enough sample for a VOC analysis. MW-109 provided somewhat more water, but still insufficient water to prepare a filtered sample for analysis.

Additional well development was conducted on MW-105, MW-108, and MW-109 to determine the effects on pH levels. The pH values subsequent to the activity showed only small decreases, approximately one pH unit. The continued relatively high pH readings indicated that when the NX borehole was filled with cement/bentonite grout (Figure II-5, Step 4), the grout was forced into fractures in the formations causing the elevated pH readings in the installed monitoring wells. The small volume of water removed from the wells due to the slow recharge had not been sufficient to "wash" out the remaining grout. The pH values continued to moderate with time, indicating a reduced effect of the grout left in the formation fractures. The first, second and third round pH readings are shown below:

Monitoring Well	pH at First Round	pH at Second Round	pH at Third Round
MW-101	8.45	8.37	8.17
MW-102	6.55	6.54	6.90
MW-103	9.05	8.98	8.82
MW-104	8.91	8.44	8.21
MW-105	9.83	7.65	8.34
MW-106	8.43	6.88	6.91
MW-107	11.55	No Water No Sample	8.38
MW-108	9.50	8.60	9.09
MW-109	12.14	9.64	8.91
MW-110	6.14	6.64	7.0
MW-111	6.49	9.07	8.74

Of the 49 target compounds selected for the Site, only three of the SVOCs (benzyl chloride, benzal chloride, and benzotrichloride) could be considered chemically reactive under alkaline conditions. However, as described in the Merck Index (Ninth Edition), each of these compounds is insoluble in water. Therefore, it is unlikely that they could have been transported into either the overburden or the bedrock flow system. These three compounds have never been detected in any of the sediment or soil samples collected at the Site. Therefore, the effect of the elevated pH levels on the reported analytical results is expected to be insignificant.

As discussed above, MW-107 and MW-109 were shown to be very low recharging wells. A surge block was used on these two wells to confirm that the development procedure outlined in the SAP was adequate for well development. For the surging process a series of neoprene rubber rings approximately 1.75 inches in diameter were bolted to the end of a 0.5 to 0.75-inch diameter threaded pipe. The rubber surge block was lowered inside the monitoring well casing to the top of the well screen elevation. The

surge block was then repeatedly raised and lowered over an approximate 3-foot interval, forcing water to flow into and out of the well casing.

Water level recharge rates are shown below for both wells and for intervals both before and after surging:

	Recharge Interval		Level Increase	
Monitoring Well	from	to	Days	(feet)
109 (pre-surge)	3/27	3/29	2	1.83
109 (pre-surge)	3/8	3/27	19	9.75
109 (post-surge)	4/8	4/10	2	1.77
109 (post-surge)	4/12	4/28	16	10.42
107 (pre-surge)	2/20	3/8	16	1.75
107 (pre-surge)	3/8	3/29	21	1.60
107 (post-surge)	4/12	4/28	16	0.92
107 (post-surge)	4/12	5/5	23	1.39

The results showed no significant change in recharge rates after surging.

PART III

SEWER SAMPLING TEST PITS

Eleven test pits were excavated adjacent to the on-site sewers at the locations shown on Figure I-2. Five of the test pits were along active sewer lines and six along abandoned lines. A backhoe was used to excavate the test pits parallel to the sewer lines and down to sewer invert elevations. After reaching invert elevation at each test pit location, one backhoe bucket of soil was removed from beneath the sewer line. The sample was removed from the center of this backhoe bucket with a decontaminated knife. The samples were analyzed for PCBs, VOCs, and SVOCs. A replicate sample was taken from Test Pit TP-5.

Test Pits TP-1 through TP-5 were excavated in January. TP-2 and TP-4 were located along an abandoned sanitary sewer and storm sewer, respectively. TP-1 and TP-5 were adjacent to the Holden sanitary sewer; however, this sewer line is not currently connected to any building on site. TP-3 was near an active Site storm sewer. For all locations, air in the vicinity of the test pits was monitored with a Photovac T.I.P. II (TIP) photoionization detector (10.2-eV lamp) or an HNU photoionization detector to assess levels of VOCs. Readings were noted in the field logbook.

In addition, logs and geologic profiles were developed in the field by a Burns & McDonnell geologist (Appendix D). Geologic profiles for the five test pits can be found in Figures III-1 through III-5. The excavated material, which consisted

of gravel fill and clay, was stockpiled and covered with plastic sheeting. The amount of excavated material ranged from 63 cubic feet from Test Pit TP-4 to 300 cubic feet from Test Pit TP-2.

Test Pits TP-6 through TP-11 were excavated in April. TP-6, TP-7, TP-8, and TP-9 were located along an abandoned Holden sanitary sewer line which was discovered near the existing Holden sanitary sewer line on the south side of the Site. The test pits were excavated to allow sampling of the soils around the line. The abandoned line was a 12-inch clay pipe located 3.7 feet north (outside to outside) of the new sewer line (see Figure I-2) and 3 feet below grade. The excavated material from these pits consisted of clay; no granular fill was encountered. Dark material was observed next to the sewer pipe in TP-7. No logs or soil profiles were developed.

Test Pits TP-10 and TP-11 are located north of the loading dock and west of the Main Building along the storm sewer exiting the Main Building to the west. The storm sewer is a 12-inch clay line approximately 3.5 feet below grade. In these excavations, fill material was encountered and a gravel layer similar to that found in the test trench dug in the Main Building (See Volume VI - Building and Structures Investigation Technical Memorandum) was found at a depth of 4 feet. No logs or geologic profiles were developed for these pits.

All of the test pits were backfilled with gravel and bentonite. The gravel was purchased from a commercial supplier and was placed in the test pits in alternating layers with the bentonite. Normally, two separate layers of bentonite, each completely covering the excavated area, were placed. The gravel was placed and compacted with the decontaminated backhoe bucket.

PART IV

GEOLOGY AND HYDROGEOLOGY

A. SOILS

1. GENERAL DESCRIPTION

The unconsolidated soils at the Site are residual in nature (derived from weathering of the bedrock) and consist of an upper brown silty clay underlain by a gray and orange mottled stiff clay. The upper clay is variable in color with brown and gray being the most common colors, and is silty with sand and gravel present in places. Roots are common. The upper clay is not found everywhere beneath the Site, but was encountered in the boreholes of MW-105/205, MW-106/206, MW-107/207, MW-109/209, MW-110/210, and MW-111/211. The thickness of the upper clay varies from 4 feet to 8 feet where penetrated by borings.

The lower clay at the Site is an orange, brown, and gray mottled clay. The lower clay was found in the boreholes of MW-104-204, MW-105/205, MW-106/206, MW-107/207, MW-109/209, MW-110/210, and MW-111/211. Thicknesses varied from 1 foot to 6 feet. The clay is iron stained with small iron concretions. The clay grades into a weathered shale bedrock at all the locations except for MW-104/204, MW-105/205, and MW-111/211. At these locations, the lower clay is underlain by a brown clay.

At the boring locations for MW-109/209 and MW-110/210, the upper and lower clays are divided by a gray-green mottled clay. The gray-green clay was 4 feet thick at MW-110/210 and 7 feet thick at MW-109/209.

At MW-104/204, MW-105/205, and MW-111/211 the orange-brown and gray mottled clay was underlain by a brown clay. The brown clay was silty in places and ranged in thickness from 2.5 feet to 7 feet.

At the location of MW-108/208, a brown clay with red and green paint chips (fill) approximately 2 feet thick was found on the top of the shale bedrock. The brown clay was iron-rich, gravelly, stiff, and damp, and graded into an iron stained weathered shale at approximately 2 feet. Elsewhere on the Site, evidence of fill was found to depths of 2 feet at the location of MW-109, 2 feet at MW-111, and at 1.5 feet in MW-206.

Soil directly beneath the floor of Main Building consisted of an upper variable clay underlain by a lower orange gray mottled clay (as found in the exterior borings). Undoubtedly some of the upper clays were fill material; however differentiating between fill and original unconsolidated overburden was not feasible. For most interior borings, the upper clay was dark brown to black, moist, medium plasticity with organic debris and gravel in places. In B-7, the interval 1 to 3 feet below floor grade consisted of a moist gray clay with gravel. In B-2, a gray clay was again found at the interval 0.8 to 1.5 feet below floor

grade. Soil beneath the South Warehouse was a wet gray/green mottled clay with high plasticity.

2. THICKNESS AND AREAL EXTENT

Soil covers the entire Site with no bedrock exposures. Thickness of the soil varies from 2 feet to 13.5 feet. A net thickness soil map is presented in Figure IV-1.

3. DEPTH TO WATER TABLE

During drilling, free water was not encountered. The screens of the shallow wells were set at the bottom of the boreholes. Over time, groundwater from the overlying soils and weathered shales accumulated in the monitoring wells.

4. ENGINEERING PROPERTIES

Seventeen soil samples were submitted to Kansas City Testing Laboratory for analysis of the engineering properties, including moisture content, Atterburg limits, and grain size distribution (hydrometer analysis). In addition, three Shelby tubes were taken to obtain undisturbed samples. These samples were tested by the consolidation method to determine hydraulic conductivity. (EM-1110-2-1906, U.S. Army Corps of Engineers, Appendix VII). Three slug tests were performed to measure in-situ hydraulic conductivity (See Part II, Section C.3).

Moisture content of the subsurface soil samples was found to range from 17.9 percent to 34.3 percent, with an average of 23.5 percent. All soil

samples analyzed for physical properties were clays as shown by the Atterburg limits analyses. Thirteen samples were classified under the Unified Soil Classification System as being clay with high plasticity, and three as silty clay with medium to low plasticity. One sample was unclassified due to small sample size. Among the samples tested, the liquid limit ranged from 44 to 87 percent, the plastic limit ranged from 19 to 28 percent, and the plasticity index ranged from 21 to 65 percent. The 11 samples submitted for hydrometer analysis had a silt and clay content that ranged from 88.2 percent to 95.6 percent with an average composition of 91 percent silt and clay. Density of the 17 soil samples ranged from medium to very dense. Laboratory test results can be found in Appendix E.

Shelby Tubes were taken from the boreholes for MW-105 (6.0 feet to 8.0 feet), MW-106 (8.0 feet to 9.5 feet) and MW-110 (8.0 feet to 10.0 feet). The hydraulic conductivities of the three samples are:

MW-105/ST-1	1.9×10^{-8} cm/sec
MW-106/ST-1	2.5×10^{-8} cm/sec
MW-110/ST-1	3.0×10^{-8} cm/sec

Slug tests were performed on MW-205 (7.5 feet to 15.0 feet), MW-206 (6.5 feet to 14.0 feet), and MW-210 (7.5 feet to 15.0 feet). The hydraulic conductivities of the monitoring wells over the area screened are:

MW-205	1.6×10^{-5} cm/sec
MW-206	4.4×10^{-5} cm/sec
MW-210	1.5×10^{-5} cm/sec

Hydraulic conducitivites also have been calculated based on water level data over time. The results of these evaluations are:

MW-206	7.6×10^{-5} cm/sec
MW-210	5.5×10^{-5} cm/sec

The large differences in hydraulic conductivity between the laboratory tests and the field tests are due to the fact that the laboratory test uses only on a small soil sample, while the field test is on the major structural features of the soil and weathered shale, including the joints and fractures. Thus, the field values are considered to be more representative of the soil weathered shale unit as a whole on the Site. The soil samples tested in the laboratory are too small to indicate the massive overall permeability of the soil structure.

B. BEDROCK

1. GENERAL DESCRIPTION

The bedrock which underlies the Site is primarily sedimentary rock of Pennsylvanian age and include sandstones, limestones, and shales, assigned to the Upper Marmaton group (Geologic Map of Missouri, Kenneth Anderson, DGLS-MDNR, 1979 and personal correspondence with Bruce Netzler, geologist, at DGLS-MDNR, March, 1989). Where encountered in

borings drilled for this project, bedrock occurs at depths ranging from 2 to 13.5 feet below ground surface of the Site, overlain by the thin mantle of unconsolidated soil.

From the top downwards, the bedrock geologic section beneath the Site generally consists of (1) a 15- to 40-foot thick sequence of shale and limestone interbeds, (2) an 8-foot thick sandstone bed, and (3) another sequence of shale and limestone beds beneath the sandstone.

The upper eroded surface of the bedrock slopes in a southwest direction at a 7 percent gradient. A top of rock contour map can be seen in Figure IV-2. In the northeast corner of the site the upper surface of the bedrock slopes slightly to the northeast.

The stratified layers within the bedrock dip to the northeast at less than 1 percent gradient. The dip of the layers varies from 0.7 percent to 0.9 percent. This is due to the variable thickness of the beds and is quite common in Pennsylvanian rocks in Western Missouri.

A stratigraphic column for the Site is presented in Figure IV-3. The uppermost formation found at the Site is the Bandera Formation. The Bandera Formation is up to 22 feet thick at the Site and is composed of an upper shale unit, a limestone unit, and a lower shale unit. The upper dark gray, laminar shale unit subcrops over the northeast portion of the Site. The upper shale contains several small localized coal beds. Underlying this shale is a strong gray limestone. The limestone

is underlain by a gray weathered shale with limestone gravel and clayey seams.

The Bandera is underlain by the Pawnee Formation. The Pawnee Formation is divided into 4 separate units. The top unit is composed of 2 limestone beds separated by a gray-green shale. Underlying this unit is a gray weathered shale approximately 8 feet in thickness. This is underlain by a light gray massive limestone. The lower unit of the Pawnee is a shale interbedded with a limestone.

The Pawnee Formation is underlain by the Labette Formation. The Labette Formation consists of massive gray shale over a shaley sandstone. The sandstone is gray, well-consolidated, and fine-grained. The sandstone is underlain by a massive dark gray shale.

The geologic profiles provided in this report (Figures II-1 through II-4) include available information on the measured hydraulic conductivities of the formations encountered. In addition, representative water level measurements for each monitoring well are also shown on the profiles.

2. BANDERA FORMATION

a. Description

The Bandera is the uppermost bedrock formation beneath most of the Site, except in the southwestern portion, where it has been removed

by erosion, and the Pawnee forms the uppermost bedrock. The Bandera is composed of an upper shale unit, a limestone unit, and a lower shale unit.

The upper unit of the Bandera is a dark gray to black laminar shale. The limestone unit is gray, strong and fossiliferous. The limestone is lenticular and is absent in MW-109 and MW-105, where a weathered gray shale and several small localized coal beds occur in this stratigraphic position. The lower shale unit is gray, laminated, weathered, and weak with limestone gravel and clayey seams. The maximum thickness of the Bandera where penetrated by borings is 22 feet.

b. Depth to Piezometric Surface

Well screens for MW-106 and MW-110 were set in the Bandera Formation. The well screen for MW-106 was set in the lower shale unit. The water elevation measured on October 2, 1989 was 822.01 feet above sea level. The well screen for MW-110 is set in the middle limestone unit and includes the small coal bed above the limestone. The water elevation for MW-110 was measured at 826.39 feet above sea level on the same date.

c. Hydraulic Conductivity

Water level measurements in Monitoring Well MW-106 were used as a slug test to calculate a hydraulic conductivity of 1.3×10^{-8} cm/sec for the Bandera.

Four packer tests were conducted in the Bandera Formation. In the borehole for MW-104, a packer test (See Part II, Section B.5) was conducted in the limestone unit at the depth interval 11 to 18 feet below ground surface. No measurable flow occurred at a pressure of 9 psi (pounds per square inch) during the packer test, indicating that the hydraulic conductivity is less than approximately $1x10^{-7}$ cm/sec. In MW-107, the packer test was conducted in the lower shale unit in the interval of 18 to 25 feet below ground surface at 14 psi. A flow rate of .225 gallons per hour was recorded, indicating a hydraulic conductivity of $6x10^{-6}$ cm/sec. Packer tests were conducted in the borehole for MW-110 over the limestone interval from 22 to 24 feet below ground surface at 20 psi and a coal interval from 19.8 to 21.8 feet below ground surface at 17 psi. No measurable flow of water occurred during either test, indicating a hydraulic conductivity of less than approximately $1x10^{-7}$ cm/sec.

3. PAWNEE FORMATION

a. General Description

The Pawnee Formation consists of interbedded shales and limestones. The Pawnee is divided into 4 separate units.

The uppermost unit (Coal City) of the Pawnee Formation is comprised of two limestone beds separated by a shale. The unit varies in thickness from approximately 6 to 9 feet. The limestones are light

gray, fossiliferous, and strong. The shale interval is a gray-green, weathered, and massive. The thickness of the shale layer varies from approximately 1 to 5 feet at different locations on the Site.

Underlying this unit is a shale (Mine Creek), approximately 8 feet in thickness. The shale is gray, weathered, and has limestone concretions. Limestone seams and lenses are found in some zones.

Underlying this unit is a limestone unit (Myrick Station) varying in thickness from approximately 5 to 8 feet. The limestone is light gray, massive, and microcrystalline, and is fossiliferous with stylolites. The contact of this unit with the overlying unit is weathered, with holes and fractures filled with green clay. This unit is apparently absent in MW-110, due to a lateral facies change.

The lower unit (Anna) within the Pawnee is a shale interbedded with limestone. The bedding is wavy. The limestone is light gray and fossiliferous and the shale is dark gray to black. The thickness of this unit is approximately 1.2 feet.

b. Depth to Piezometric Surface

Well screens for MW-105, MW-107, and MW-109 were set in the Pawnee Formation. MW-105 and MW-107 were set in the lower limestone member (Myrick Station). The measured water elevation for MW-105 was

821.33 feet above sea level on October 2, 1989. Due to the low permeability of this formation, approximately two weeks were required for the water level to stabilize in MW-105 while the water level in MW-107 never stabilized throughout the duration of this study. The screen for MW-105 is set in the upper weathered zone of the limestone unit while the screen for MW-107 is set in the lower non-weathered part of the unit, and this may account, in part, for the difference in recharge rates.

The well screen for MW-109 is set in the upper limestone unit (Coal City) of the Pawnee. The water level in this well has likewise may not have reached equilibrium during this study. The highest water elevation recorded was 819.26 feet above sea level on October 2, 1989.

c. Hydraulic Conductivity

Water level measurements in Monitoring Well MW-109 were used as a slug test to calculate a hydraulic conductivity of 2.5×10^{-8} cm/sec in the Pawnee Formation.

Five packer tests (Part II, Section B.5) were performed in the various strata of the Pawnee formation. In MW-107, packer tests were conducted in both the upper and lower limestone strata of the Pawnee (39.5 feet to 46.5 feet and 27 feet to 35 feet below ground surface). During the tests of both strata, at 14 and 22 psi, respectively, no measurable flow occurred, indicating that the

hydraulic conductivity is less then approximately $1x10^{-7}$ cm/sec. In the borehole for MW-110, a packer test was conducted in the upper limestone unit of the Pawnee Formation (33.5 feet to 35.5 feet below ground surface). A flow rate of .0075 gallons per hour at 26.8 psi was measured, yielding a hydraulic conductivity of 3×10^{-7} cm/sec. In the borehole for MW-104, packer tests were conducted in both the upper and lower limestones of the Pawnee Formation (intervals 20 feet to 27 feet and 35 feet to 41 feet below ground surface). No measurable flow rate at 16 and 27 psi, respectively, occurred during the test, indicating that the hydraulic conductivity is less than approximately $1x10^{-7}$ cm/sec.

4. LABETTE FORMATION

a. Description

The Labette Formation of the Marmaton Group consists predominantly of a sandstone and includes massive gray shale strata at the top and bottom of the formation.

The sandstone of the Labette Formation of the Marmaton group was encountered in MW-104, MW-108, and MW-111 and was also encountered in the existing MW-101 and MW-103. The sandstone is a shaley calcareous sandstone and is gray, well cemented, and fine grained, with traces of muscovite and biotite. The sandstone has laminar bedding with no visible fractures or joints where encountered in the core borings. The sandstone is interbedded with black to dark gray

shale. The upper contact of the sandstone is gradational with a 1-1/2-foot thick dark gray to black shale present above the sandstone. The formation increases in sandstone content downward until the bulk of the formation is a sandstone with intermittent shale lenses. The sandstone then becomes increasingly more shaley with depth, becoming interbedded shale and sandstone in the lower part of the sandstone unit. The lower contact of the sandstone at the Site is seen only in MW-111 and is a gradational contact with the underlying dark gray massive shale.

The dip of the top of the Labette Sandstone is 0.7 percent to the northeast. The thickness of the sandstone in MW-111 is 9 feet.

Overlying the Labette Formation are the interbedded shales and limestones of the Pawnee Formation. Underlying the Labette are the interbedded shales and limestones of the Higginsville, Little Osage, and Blackjack Creek Formations.

The Higginsville Formation was reached at the borehole for MW-111 at an approximate elevation of 770 above sea level. The Higginsville Formation was a light gray limestone, fine grained, massive, and strong. The boring penetrated a total of 2.7 feet into the formation.

b. Depth to Piezometric Surface

MW-104, MW-108, and MW-111, were screened in the sandstone of the Labette Formation. Several rounds of water level measurements were

taken for this investigation to determine directions of groundwater flow in the Labette.

The measured water elevations within the sandstone were 810.92 feet in MW-104, 809.21 feet in MW-108, and 809.65 feet in MW-111, measured on October 2, 1989. The piezometric surface slopes northwestward at an approximate gradient of 0.01.

c. Hydraulic Conductivity

A packer test was performed on the sandstone in MW-104. The flow rate during the packer test was 0.06 gallons per hour at 34 psi, resulting in a calculated hydraulic conductivity of approximately $1x10^{-6}$ cm/sec (See Part II, Section B.5). A slug test was also performed for MW-104 (See Part II, Section B.7). The hydraulic conductivity of the sandstone as calculated from the slug test is $2.5x10^{-6}$ cm/sec. Water level measurements in Monitoring Wells MW-101 and MW-103 were used to calculate hydraulic conductivities of 7.0×10^{-9} cm/sec and 1.7×10^{-8} cm/sec, respectively, for the shales and limestones immediately underlying the sandstone bed of the Labette.

C. HYDROGEOLOGY

1. GENERAL DESCRIPTION

There are three primary hydrogeologic units of concern in the shallow subsurface (0 to 50 feet) at the Site. From the surface downward, these include the unconsolidated soil and weathered shale overburden (hereafter referred to as overburden), a series of thick shale and thin limestone interbeds, and a sandstone stratum which comprises the principal water bearing unit beneath the Site. The sandstone is underlain by additional shale and limestone beds. The extremely low permeability (less than 10^{-5} cm/sec) of all of the shallow subsurface materials precludes the classification of these geologic materials as aquifers. Minimum hydraulic conductivities for aquifers are considered to be in the range of 5×10^{-3} cm/sec. These characteristics, plus the availability of local public water supplies, preclude the installation of drinking water production wells in the shallow subsurface on or near the Site.

2. GEOLOGIC ASPECTS

As described above, the principal water bearing unit in the bedrock is the sandstone bed in the Labette Formation. It is a bedrock unit which underlies shale and limestone interbeds which, in turn, are overlain by unconsolidated overburden soil. Where penetrated by borings, the sandstone ranges in thickness from approximately 7 to 9 feet. The areal distribution of this sandstone bed can be seen on the geologic profiles

in Figures II-1 through II-4. Although no major joints were observed in the rock core recovered from this unit, both bedding plane joints and structural joints undoubtedly contribute to the porosity and permeability of the formation. The sandstone bed lies between confining layers, both above and below, of very low permeability shale and limestone interbeds, and is overlain additionally by the overburden. The depth to the top of the sandstone ranges from approximately 31 to 44 feet below ground surface at different locations on the Site. The depth to the piezometric surface of the groundwater within the sandstone ranges from approximately 4 to 10 feet below ground surface at different locations on the Site. Thus the piezometric surface generally occurs at an elevation of approximately 810 feet above sea level.

The second water-bearing unit on the Site which requires consideration is the overburden. Although the overburden consists primarily of clay and silty clay, its in-situ permeability as measured by slug tests is substantially higher than that of the underlying shale and limestone bedrock. It thus provides a location where groundwater may occur in a perched condition on top of the bedrock. Where penetrated by borings on the Site, the overburden ranges in thickness from approximately 5 feet to 16 feet. The overburden blankets the entire Site, and no bedrock outcrops were discovered during the investigation. The porosity of the overburden consists primarily of discontinuities such as joints and minor fractures, with some primary pore space in the form of intergranular porosity. Although it is of generally low permeability, the overburden contains water in unconfined conditions, because it is

the shallowest formation on the Site. The water table within the overburden generally occurs within a saturated zone at depths from approximately 1 to 12 feet below the ground surface. Thus, the groundwater within the overburden comprises a very small volume of water that is apparently perched on top of the bedrock surface. Figure II-22 illustrates the general shape of the shallow water table surface for April 5, 1989. The contours closely reflect the shape of the top of the bedrock surface as shown on Figure IV-2.

3. HYDRAULIC ASPECTS

a. Labette Sandstone

The sandstone within the Labette Formation has a hydraulic conductivity in the range of $1x10^{-6}$ cm/sec. The transmissivity of the sandstone is approximately 0.19 gallons per day per foot ($1x10^{-6}$ cm/sec x gal/3,785 cm^3 x 929 cm^2/ft^2 x 86,400 sec/day x 9 ft). The storage coefficient of the sandstone will be in the range of 0.00001, and the porosity of the formation is estimated at approximately 35 percent.

The groundwater flow direction within the sandstone is predominantly horizontal, because it is lies between the confining layers of low permeability shale. On several dates of measurement, groundwater flow was seen to be generally west northwest or northwestward. Due to the extremely low gradient of the piezometric surface, slight variations in elevations of water measured in the monitoring wells

will yield somewhat different compass directions of groundwater flow.

The groundwater flow rate within the sandstone beneath the Site is calculated to be approximately 1.2 gallons per day, based on the following parameters: hydraulic conductivity - 0.02 gallons per day per square foot; hydraulic gradient - 0.01; and cross sectional area perpendicular to flow - 5,400 square feet (9 feet thick by width perpendicular to flow of approximately 600 feet). Assuming a porosity of 35 percent, the average linear groundwater velocity is calculated to be approximately 0.00008 feet per day, equivalent to approximately 0.03 feet per year. The principal recharge area for the sandstone is the upland area to the south and southeast of the Site, where infiltration of groundwater recharges the sandstone at locations where the sandstone outcrops or the limestone and shale aquitard is shallow or nonexistent. This recharge area will provide the main underflow within the sandstone beneath the Site. However, additional minor recharge will occur into the sandstone beneath the entire Site. This recharge will occur as rainfall percolates downward at slow rates through overlying shales and limestones. The discharge area for the sandstone is outcrops and subcrops in the ravine bottom of East Pin Oak Creek approximately 7,000 feet north and northwest of the Site. At that location the groundwater within the sandstone will discharge to the surface water. Seasonal variations of the groundwater flow within the sandstone are expected to be very minor because of the extremely slow flow rates within the

sandstone and its location between two aquitards.

b. Overburden

Laboratory tests for hydraulic conductivity were performed on selected overburden soil samples. These tests yielded a hydraulic conductivity of approximately $2x10^{-8}$ cm/sec. However, field tests of hydraulic conductivity by in-situ testing (slug tests) were also performed. The slug tests yielded values in the range of $1.5x10^{-5}$ cm/sec to $7.6x10^{-5}$ cm/sec. The large differences in hydraulic conductivity between the laboratory tests and the field tests are due to the fact that the laboratory test is only on a small soil sample, while the field test is on the major structural features of the overburden, including the joints and fractures. Thus, the field values are considered to be more representative of the overburden unit as a whole on the Site. The soil samples tested in the laboratory are too small to indicate the massive overall hydraulic conductivity of the soil structure. The transmissivity of the overburden unit will be extremely low and highly variable due to the fact that the water in that formation comprises primarily water perched on top of the bedrock formations. Thus the variations in thickness of the saturated section may vary significantly across the Site. However, where the saturated thickness is approximately 3 feet, the transmissivity is calculated to be approximately 2.4 gallons per day per foot. The storage coefficient for this unit will be approximately 0.001, representing an unconfined condition, in a relatively low permeability formation. The porosity of the

formation is estimated at approximately 40 percent. The groundwater within this unit is primarily unconfined, but due to the low permeability of the soil material, semi-confined conditions may exist for some of the water perched on top of the bedrock.

The groundwater flow direction generally parallels the upper bedrock surface. Thus the predominant groundwater flow in the overburden is to the southwest. The hydraulic gradient to the southwest will generally be the same as the slope of the eroded bedrock surface in that direction which is approximately 0.15. The flow rate of the perched water beneath the Site is approximately 360 gallons per day beneath the entire Site. This calculation was made using a hydraulic conductivity of $4x10^{-5}$ cm/sec., the hydraulic gradient of 0.15 and a cross sectional area of 3,000 square feet (consisting of a 3-foot-thick saturated zone over a width perpendicular to the direction of flow of approximately 1,000 feet). The average linear groundwater velocity is calculated to be 0.04 feet per day which is equivalent to approximately 15 feet per year.

The recharge for the overburden is rainfall on the entire Site percolating downward to the perched water table zone. In addition, surface water runoff from off-site may enter onto the Site and contribute to recharge on the Site. However, the size of the area off-site which drains onto the Site itself is small. The discharge area for the groundwater in the soil overburden will be the subcrop and rock outcrop areas in the unnamed tributary to East Pin Oak

Creek which occurs on the southwestern part of the Site and generally to the west of the Site. In this ravine bottom, where the ground surface has been eroded down to nearly the top of the bedrock surface, the perched water on the top of the bedrock will discharge to the surface water in the ravine. It should be noted that in the northeastern corner of the site, the bedrock surface slopes downward to the northeast. In this portion of the Site, the groundwater within the overburden appears to flow first northeastward and then to the northwest eventually to discharge in East Pin Oak Creek northwest of the Site.

Seasonal variations in the groundwater flow conditions in the unconfined overburden may be substantial, because it is directly sourced by rainfall on the ground surface. During times of heavy rainfall, the water table elevation (and saturated thickness of the overburden) may vary by as much as 1 foot, or possibly more. This seasonal variation in water levels is not anticipated to have a significant effect on the evaluation of groundwater flow beneath the Site.

PART V

DECONTAMINATION

All decontamination procedures for the drilling, excavation, and sampling equipment are described in this Section.

A. DRILLING AND EXCAVATION EQUIPMENT

All drilling equipment, excavating equipment, and PVC well construction material was decontaminated by Layne-Western prior to each use for the various stages of drilling and well installation. With reference to figure II-5, these include before Step 1, between Steps 2 and 3, and between Steps 4 and 5. A decontamination area, consisting of a metal open-top water tank underlain by plastic sheeting, was set up by Layne-Western prior to drilling. All augers and drill rods were placed in the open-top tank and cleaned using a high-pressure hot water sprayer. All exposed exterior and interior surfaces of the augers and drill rods were cleaned until all visible soil was removed. The Holden city water was characterized by chemical analysis prior to use for decontamination.

The backhoe bucket was decontaminated by Layne-Western, both prior to excavation and between test pits. The backhoe bucket was placed in the open-top tank and cleaned using a high-pressure hot water sprayer. All exposed surfaces were cleaned until all visible soil was removed.

After all visible soil was removed from the drilling and excavation equipment, the following decontamination procedure was performed:

1. The augers, drill rods, and backhoe bucket were scrubbed with an Alconox solution consisting of one tablespoon of Alconox per one gallon of water.

2. The equipment was then rinsed with a supply of pesticide-grade methanol contained in sprayers.

3. A final rinse of the equipment was made using deionized water.

B. SOIL AND WATER SAMPLING EQUIPMENT

All split-barrel soil samplers, stainless steel sample knives, groundwater sampling equipment, and water level measuring equipment was decontaminated prior to the collection of each sample.

The following arrangements were made for decontamination of sampling equipment:

1. The Holden potable water supply was chemically analyzed prior to use and not found to contain any constituents of concern.

2. A galvanized wash tub or a clean 5-gallon plastic container was filled with potable water. An Alconox solution was mixed in the container consisting of one tablespoon of Alconox per one gallon of water.

3. A supply of pesticide-grade methanol was placed in labeled 1-quart plastic squeeze bottles or sprayers.

4. An empty container was provided to contain the methanol rinsings.

5. Deionized water was provided in labeled 1-quart plastic squeeze bottles or sprayers.

Prior to sampling, the sampling equipment was scrubbed clean using the Alconox solution and a stiff long bristle scrub brush. After the solution scrub, the device was rinsed with deionized water and then sprayed with methanol over the second container. After the methanol rinse, the devices were allowed to dry. All decontamination fluids were retained and treated and/or disposed of as described in Part VI.

PART VI

INVESTIGATION GENERATED WASTES

Field investigation activities resulted in the generation of potentially contaminated materials. Management of the wastes generated during the investigation required compliance with federal and state requirements for generation, storage, transportation, and disposal. Potentially contaminated materials generated during the field investigation included such materials as decontamination fluids, disposable clothing and equipment, drill cuttings, and well-development and purging water.

All investigation generated solid wastes will be disposed of off-site at Chemical Waste Management's TSCA/RCRA landfill in Emelle, Alabama. All decontamination fluids, and well-development and purging waters were collected and treated on site using a Carb-trol activated carbon adsorption system.

Wastes generated by the field operations consisted of:

- Drilling Fluids. These fluids include water used during the drilling and water used to flush the borehole. The water was collected and pumped to an on-site open-top tank for storage and subsequent treatment.

- o Decontamination Fluids. These fluids included wash waters and methanol used to decontaminate personal safety equipment and drilling and sampling equipment. The wash waters were collected and pumped to an on-site open-top tank for storage and subsequent treatment. The methanol was collected in a 55-gallon drum for the later disposal.

- o Well Development and Purging Water. These generated wastes include the groundwater obtained from monitoring well development and pre-sampling monitoring-well purging activities. These fluids will be collected and treated in the same manner as the decontamination fluids described above.

- o Personal Protective Clothing and Equipment. This category includes the disposable work clothing such as boot covers, gloves, tyvek coveralls, and spent respirator cartridges worn on-site by field personnel during the field investigation. The procedure for handling disposable personal protective clothing is to place such articles in DOT (Department of Transportation)-approved 55-gallon drums which are stored on-site until the completion of the field investigation.

- o Drill Cuttings. These are soil and rock generated during the drilling of the monitoring wells. These drill cuttings and soil materials were stockpiled and covered by plastic sheeting to be disposed of off-site at a later time.

- Excavated Material. All material excavated during the sampling of the test pits was stockpiled and covered by plastic sheeting to be disposed of off-site at a later time.

* * * * *

TABLES

Table II-1
SOIL SAMPLE MATRIX

Monitoring Well No.	Sample No.	Sample Interval (Ft.)	Sample Type	Chemical Analyses			Engineering Properties Analyses			Consolidation Permeability
				PCBs	VOCs	Semivol.	%Moisture	Atterburg Limits	Hydrometer	
MW-104	SS-1	0.0-2.0	Split-Spoon	X	X	X				
	SS-2	2.0-3.0	Split-Spoon	X	X	X				
MW-105	SS-1	0.5-2.0	Split-Spoon							
	SS-3	4.0-6.0	Split-Spoon	X	X	X				
	SS-4	8.0-9.5	Split-Spoon							
	SS-5	9.5-10.0	Split-Spoon	X	X	X	X	X		
	SS-6	10.0-10.8	Split-Spoon							
	SS-7	10.8-11.7	Split-Spoon							
	ST-1	6.0-8.0	Shelby Tube				X			X
MW-106	SS-1	0.0-2.0	Split-Spoon							
	SS-2	2.0-4.0	Split-Spoon							
	SS-4	6.0-8.0	Split-Spoon	X	X	X				
	SS-5	9.5-11.5	Split-Spoon	X	X	X				
	SS-6	11.5-13.5	Split-Spoon	X	X	X	X	X	X	
	SS-7	13.5-13.9	Split Spoon							
	SS-10*	6.0-8.0	Split-Spoon		X					
	SS-11*	9.5-11.5	Split-Spoon	X		X				
	ST-1	8.0-9.5	Shelby Tube				X			X
MW-107	SS-1	0.0-2.0	Split-Spoon							
	SS-3	4.0-6.0	Split-Spoon	X	X	X				
	SS-4	8.0-10.0	Split-Spoon	X	X	X	X	X	X	
	SS-5	10.0-12.0	Split-Spoon							
	SS-6	12.0-12.4	Split-Spoon							
	ST-1	6.0-8.0	Shelby Tube							
MW-108	SS-1	0.0-2.0	Split-Spoon	X	X	X				
	SS-2	2.0-4.0	Split-Spoon							
	SS-3	4.0-6.0	Split-Spoon	X	X	X	X	X	X	
	SS-4	6.0-6.7	Split-Spoon							

Table II-1
SOIL SAMPLE MATRIX
(Continued)

Monitoring Well No.	Sample No.	Sample Interval (Ft.)	Sample Type	Chemical Analyses			Engineering Properties Analyses			
				PCBs	VOCs	Semivol.	%Moisture	Atterburg Limits	Hydrometer	Consolidation Permeability
MW-109	SS-1	0.0-2.0	Split-Spoon							
	SS-2	2.0-4.0	Split-Spoon							
	SS-3	4.0-6.0	Split-Spoon	X	X	X				
	SS-4	6.0-8.0	Split-Spoon							
	SS-5	8.0-10.0	Split-Spoon	X	X	X				
	SS-6	10.0-12.0	Split-Spoon							
	SS-7	12.0-13.2	Split-Spoon							
	SS-8	14.0-14.7	Split-Spoon							
MW-110	SS-1	0.0-2.0	Split-Spoon							
	SS-2	2.0-4.0	Split-Spoon							
	SS-3	4.0-6.0	Split-Spoon	X	X	X				
	SS-4	6.0-8.0	Split-Spoon							
	SS-5	10.0-12.0	Split-Spoon	X	X	X	X	X	X	
	SS-6	12.0-14.0	Split-Spoon							
	SS-7	15.0-16.7	Split-Spoon							
	ST-1	8.0-10.0	Shelby Tube				X			X
MW-111	SS-1	0.0-2.0	Split-Spoon							
	SS-2	2.0-4.0	Split-Spoon							
	SS-3	4.0-6.0	Split-Spoon							
	SS-4	6.0-8.0	Split-Spoon							
	SS-5	8.0-10.0	Split-Spoon	X	X	X				
	SS-6	10.0-12.0	Split-Spoon	X	X	X	X	X	X	
	SS-7	12.0-14.0	Split-Spoon							
	SS-8	14.0-14.5	Split-Spoon							
	SS-11*	10.0-12.0	Split-Spoon	X	X	X				
	SS-10**	8.0-10.0	Split-Spoon	X	X	X				

*—*Replicate sample.*
**—*EPA replicate sample.*

Table II-2
PACKER TESTS FOR
IN-SITU HYDRAULIC CONDUCTIVITY

Monitoring Well No.	Depth Interval (Ft.)	Pump Pressure (psi)	Flow Rate (Gallons/Hr.)	Hydraulic Conductivity (cm/sec)
MW-104	11-18	9	0	$<1 \times 10^{-7}$
	20-27	16	0	$<1 \times 10^{-7}$
	35-41	27	0	$<1 \times 10^{-7}$
	42-46	34	.06	1×10^{-6}
MW-107	18-25	14	.225	6×10^{-6}
	27-35	22	0	$<1 \times 10^{-7}$
	39.5-46.5	32	0	$<1 \times 10^{-7}$
MW-110	19.8-21.8	17	0	$<1 \times 10^{-7}$
	22-24	20	0	$<1 \times 10^{-7}$
	33.5-35.5	26.8	.0075	3×10^{-7}

Table II-3
PACKER TEST INTERVALS

Monitoring Well	Packer Test Interval (Ft.)		Screened Interval in Well	
	Depth	Elevation	Depth	Elevation
MW-104	11-18	812.3-805.3	41-46	782.3-777.3
	20-27	803.3-796.3		
	35-41	788.3-782.3		
	42-46	781.3-777.3		
MW-105			45-50	789.1-784.1
MW-106			22-26	809.2-805.2
MW-107	18-25	813.4-806.4	43-48	788.4-783.4
	27-35	804.4-796.4		
	39.5-46.5	791.9-784.9		
MW-108			42-47	784.0-779.0
MW-109			36-41	799.7-794.7
MW-110	19.8-21.8	816.5-814.5	20-25	816.3-811.3
	22-24	814.3-812.3		
MW-111			33-38	782.4-777.4

FIGURES

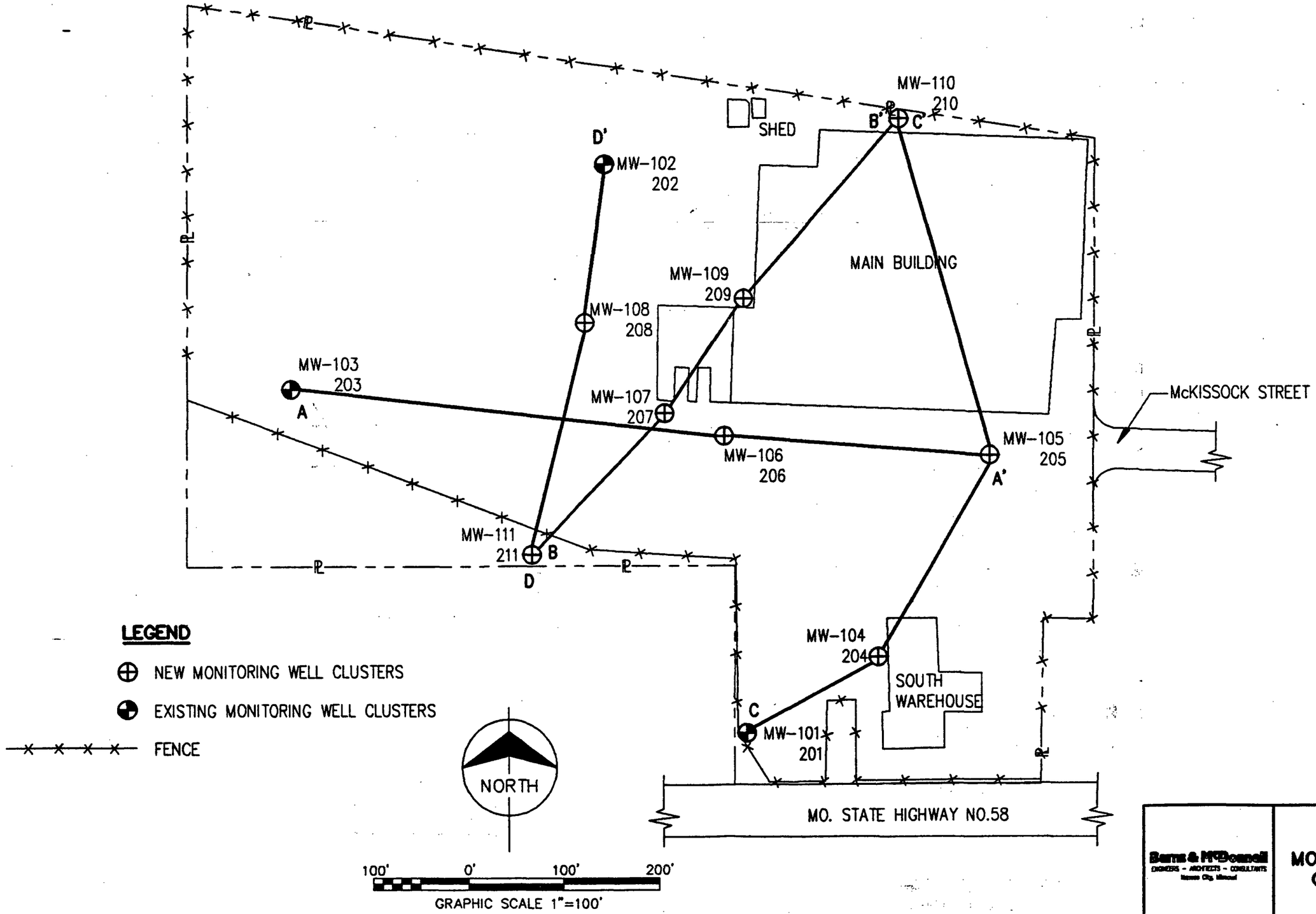

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FIGURE 1-1
MONITORING WELL AND GEOLOGIC PROFILE LOCATIONS

ROSE02 7-7-89

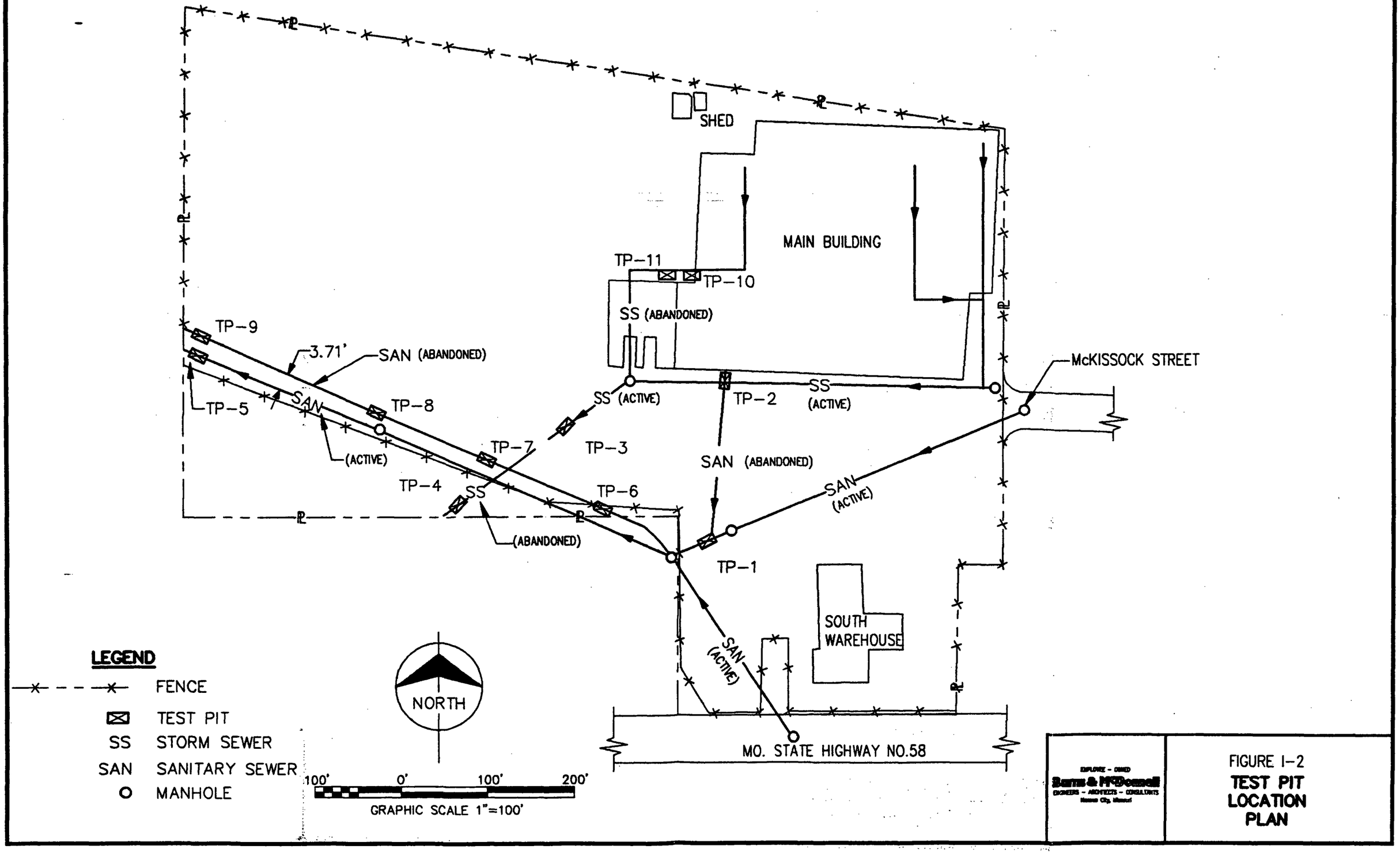

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FIGURE I-2
TEST PIT LOCATION PLAN

ROSE03 7-13-89

APPROXIMATE ELEVATION

WEST

EAST

APPROXIMATE GROUND SURFACE

GROUND SURFACE ELEVATION → (831.2)

BORING NO. → MW-106

DEPTH BELOW GROUND SURFACE (TYP.)

A
(812.3)
MW-103

A'
(834.1)
MW-105

MW-203

MW-205

MW-206

CLY

SH

SH&LS,INTR

LS

LS&SH INTRBD

SH

SS W/SH

SH,SDY

SH

LS

CLY,SLTY

CLY

SH

LS

SH

LS,SH PARTINGS

SH

LS

SH

NR

LS

CLY,SLTY

SH

COAL

SH

COAL

SH

NR

SH

LS

SH

LS

SH

LS

SH

NR

LS

8.0

13.0
15.5
17.0

13.5

20.3
22.0

27.9
29.2
31.3
33.9

38.2

42.3

47.7

37.7

47.7

27.9
28.7
30.6

33.8

42.2

50.0

9.4

17.5
19
20

27.8
30.0
31.4
32.3

36.0
37.5

40.0
41.0

46.1

50

$K = 7.6 \times 10^{-5}$ CM/SEC

$K = 6.8 \times 10^{-6}$ CM/SEC.

$K = 1.3 \times 10^{-8}$ CM/SEC

$K = 1.7 \times 10^{-8}$ CM/SEC

BANDERA FORMATION

PAWNEE FORMATION

LABETTE FORMATION

HIGGINSVILLE FORMATION

840
830
820
810
800
790
780
770
760

* BASED ON THE REPORT:
ROSE CHEMICAL PROJECT , HOLDEN MISSOURI, SITE INVESTIGATION, PRELIMINARY SITE ASSESSMENT REPORT, JOHN MATHES & ASSOCIATES, INC., JULY 1987.

VERTICAL 10 0 10 20
SCALE IN FEET

HORIZONTAL 60 0 60 120
SCALE IN FEET

VERTICAL EXAGGERATION 6:1

LEGEND

GROUND SURFACE
APPROXIMATE TOP OF BEDROCK
APPROXIMATE GEOLOGIC CONTACTS
SHALLOW MONITORING WELL

SCREENED ZONE IN MONITORING WELL

SCREENED ZONE IN MONITORING WELL *

CLY - CLAY
SH - SHALE
LS - LIMESTONE
SS - SANDSTONE
NR - NOT RECOVERED
▼ - WATER LEVEL OCTOBER 2,1989

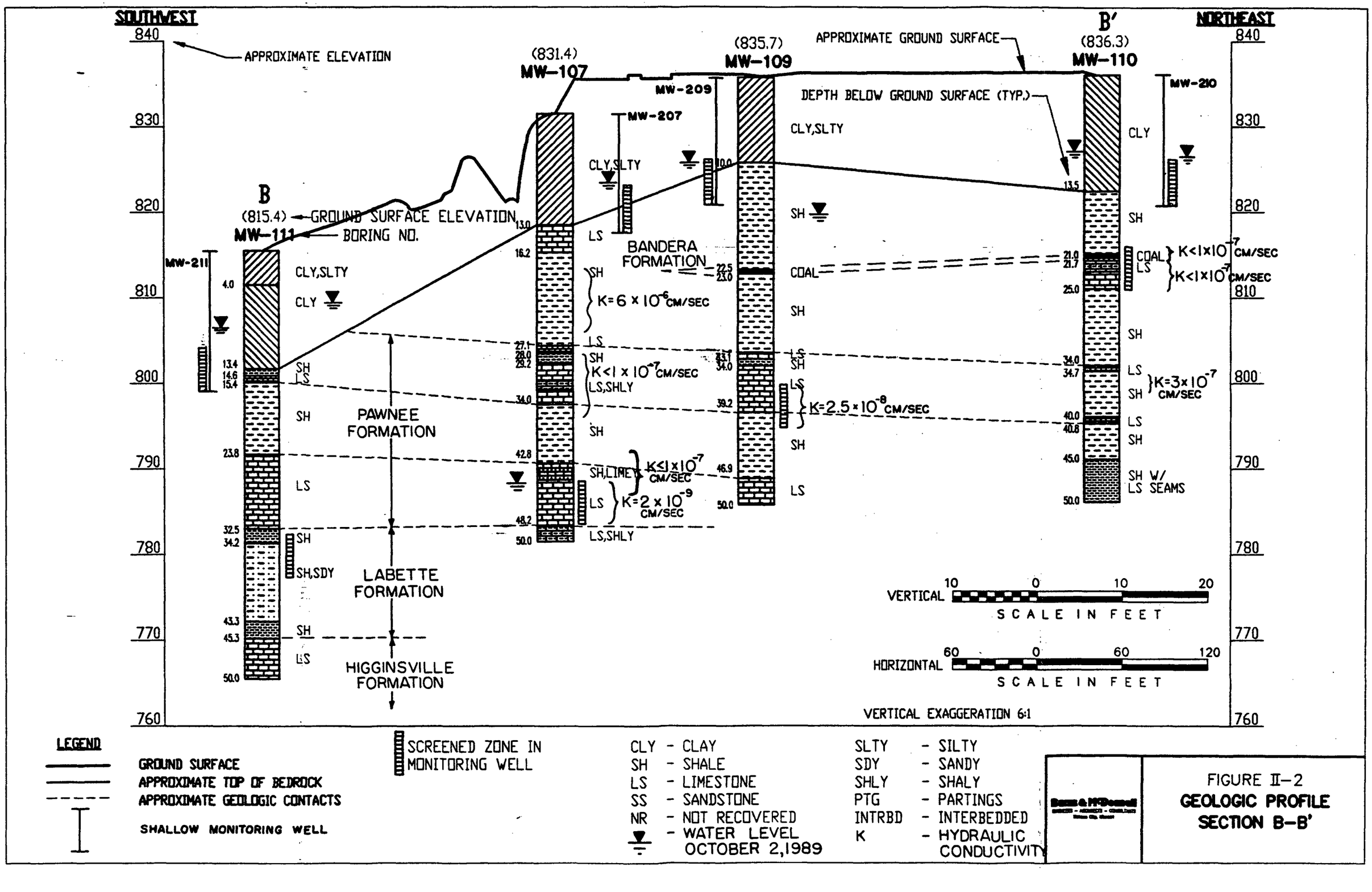
SLTY - SILTY
SDY - SANDY
SHLY - SHALY
PTG - PARTINGS
INTRBD - INTERBEDDED
K - HYDRAULIC CONDUCTIVITY

Burns & McDonnell

FIGURE II-1

GEOLOGIC PROFILE SECTION A-A'

3-18-89



LEGEND

GROUND SURFACE
APPROXIMATE TOP OF BEDROCK
APPROXIMATE GEOLOGIC CONTACTS
SHALLOW MONITORING WELL
SCREENED ZONE IN MONITORING WELL

CLY - CLAY
SH - SHALE
LS - LIMESTONE
SS - SANDSTONE
NR - NOT RECOVERED
WATER LEVEL OCTOBER 2,1989
SLTY - SILTY
SDY - SANDY
SHLY - SHALY
PTG - PARTINGS
INTRBD - INTERBEDDED
K - HYDRAULIC CONDUCTIVITY

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FIGURE II-2
GEOLOGIC PROFILE SECTION B-B'

GEB-B 3-18-89

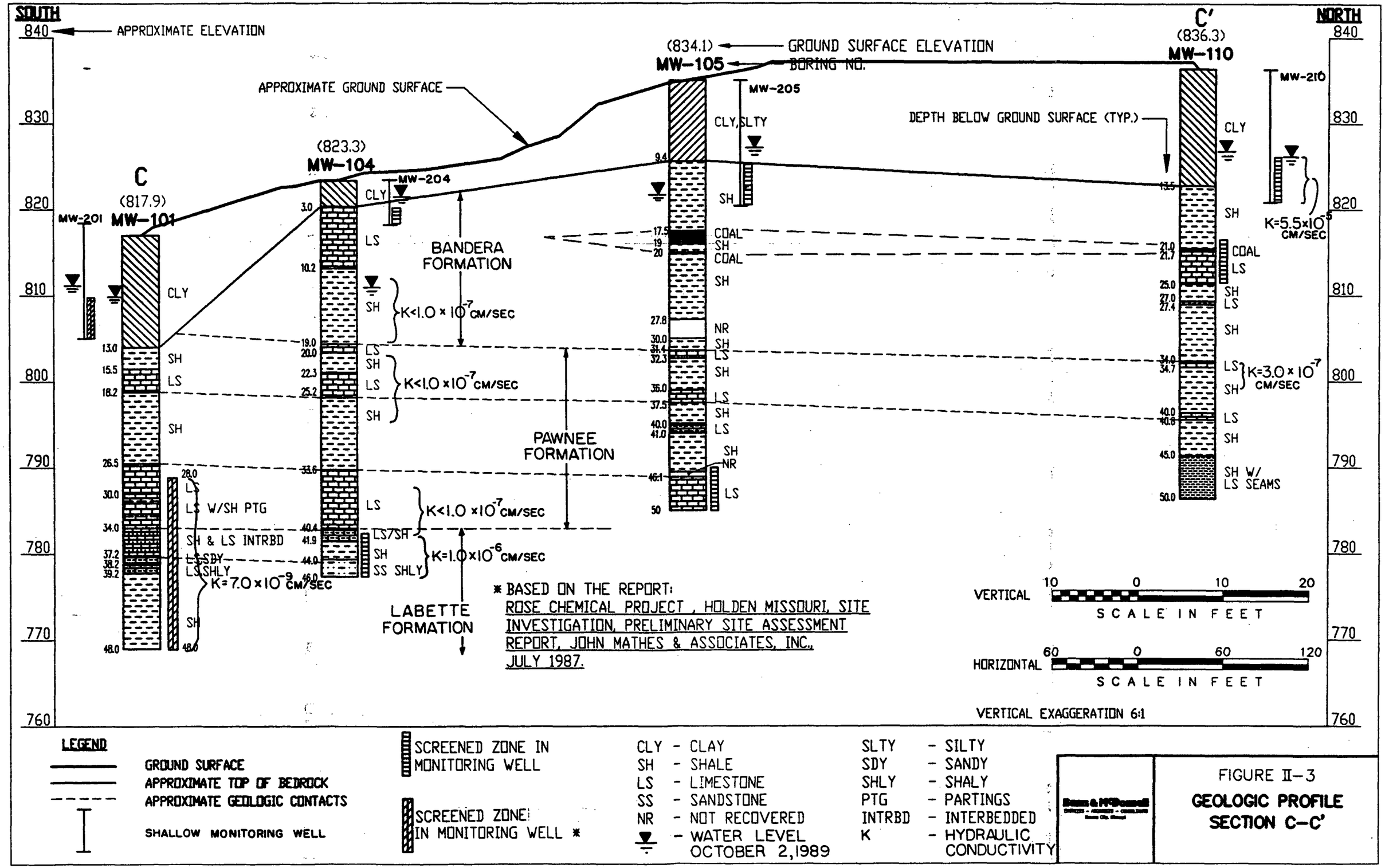
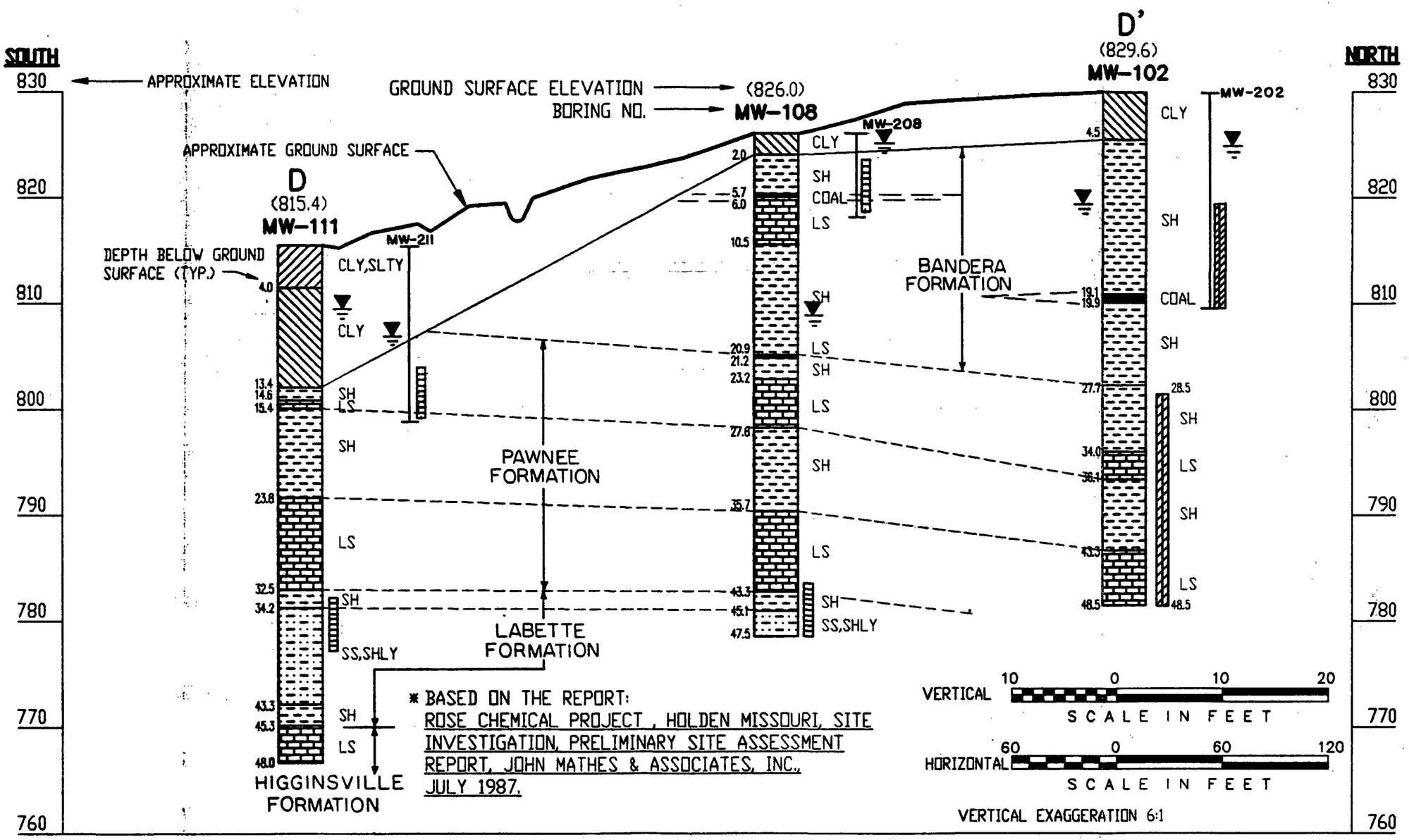


FIGURE II-3

GEOLOGIC PROFILE SECTION C-C'

DCB-C
3-18-89



LEGEND

- GROUND SURFACE
- APPROXIMATE TOP OF BEDROCK
- APPROXIMATE GEOLOGIC CONTACTS
- SHALLOW MONITORING WELL
- SCREENED ZONE IN MONITORING WELL
- SCREENED ZONE IN MONITORING WELL *

CLY - CLAY
SH - SHALE
LS - LIMESTONE
SS - SANDSTONE
NR - NOT RECOVERED
▼ - WATER LEVEL OCTOBER 2, 1989

SLTY - SILTY
SDY - SANDY
SHLY - SHALY
PTG - PARTINGS
INTRBD - INTERBEDDED
K - HYDRAULIC CONDUCTIVITY

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FIGURE II-4

GEOLOGIC PROFILE SECTION D-D'

D-D
3-18-89

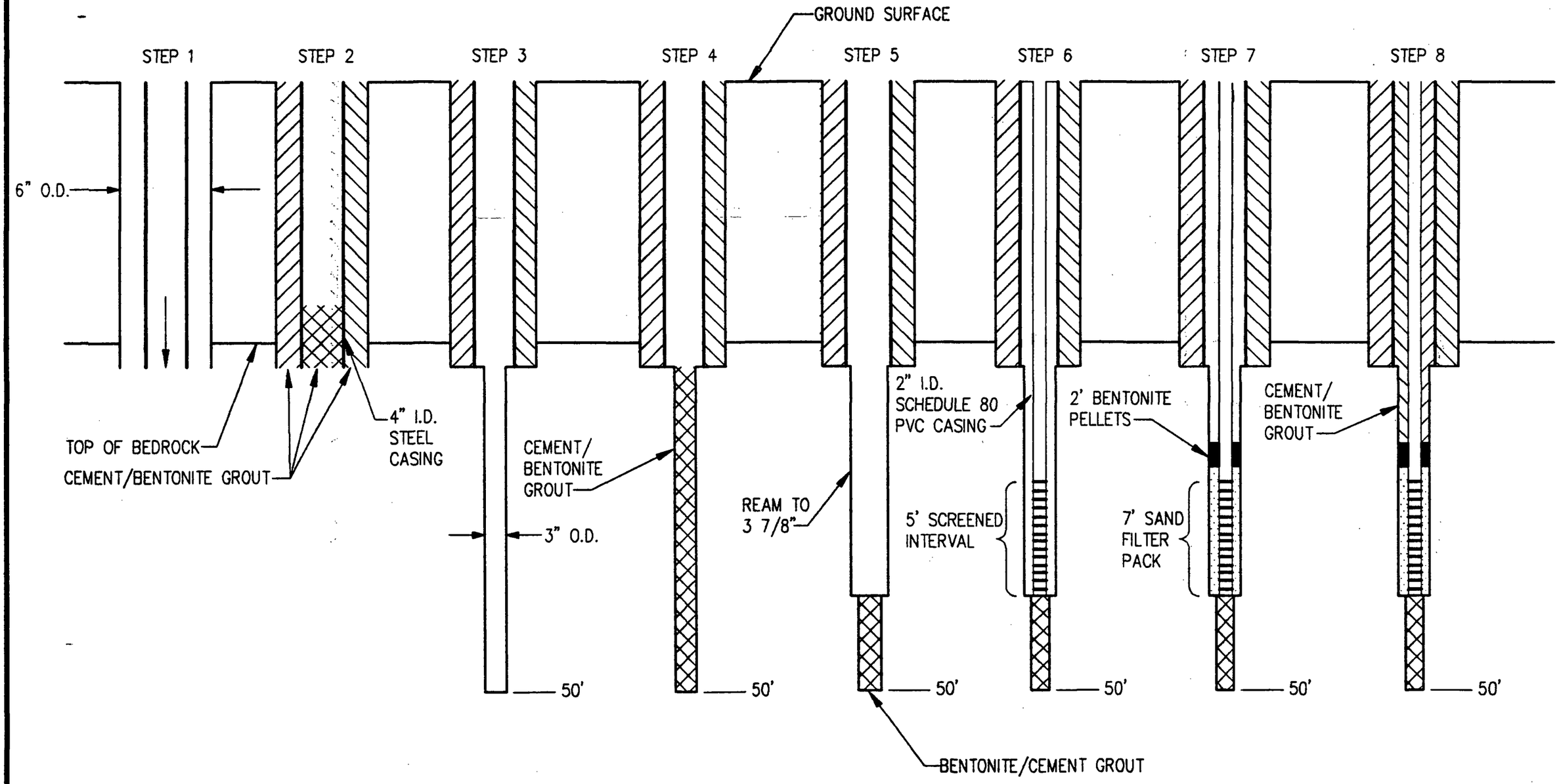

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FIGURE II-5
DEEP MONITORING WELL CONSTRUCTION STEPS

ROSE07 7-10-89

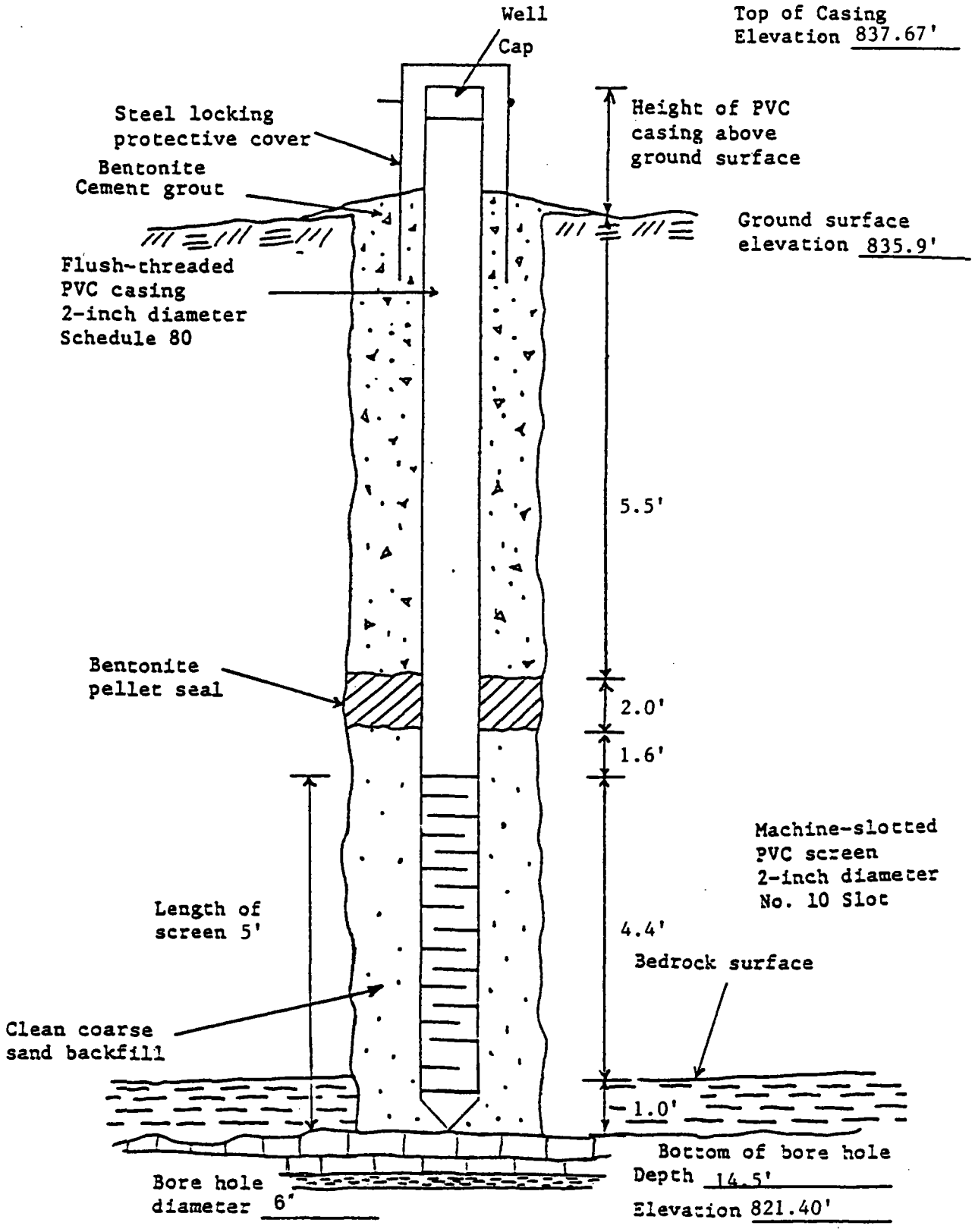


Figure II-19
MONITORING WELL CONSTRUCTION RECORD, MW-209

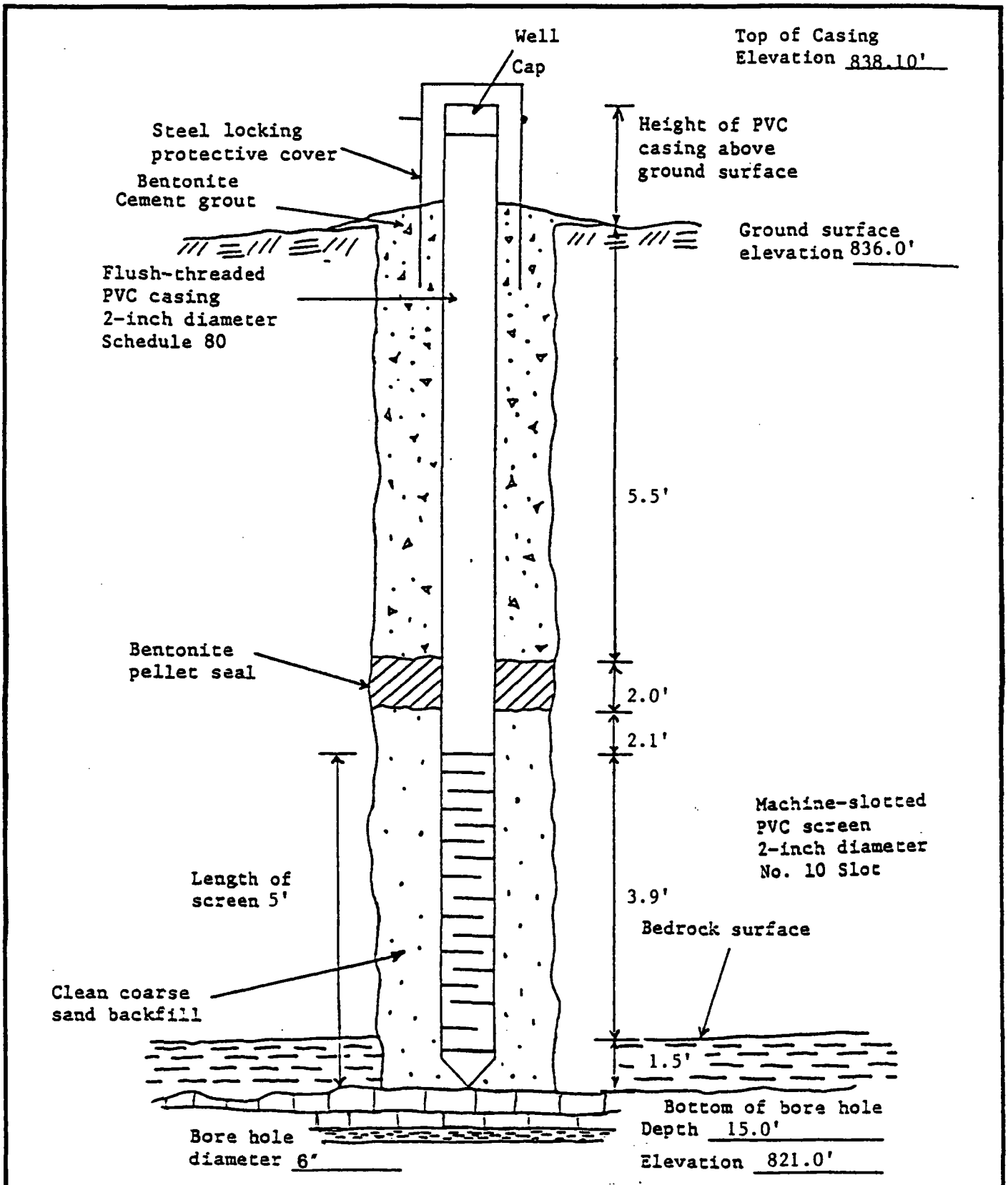


Figure II-20
MONITORING WELL CONSTRUCTION RECORD, MW-210

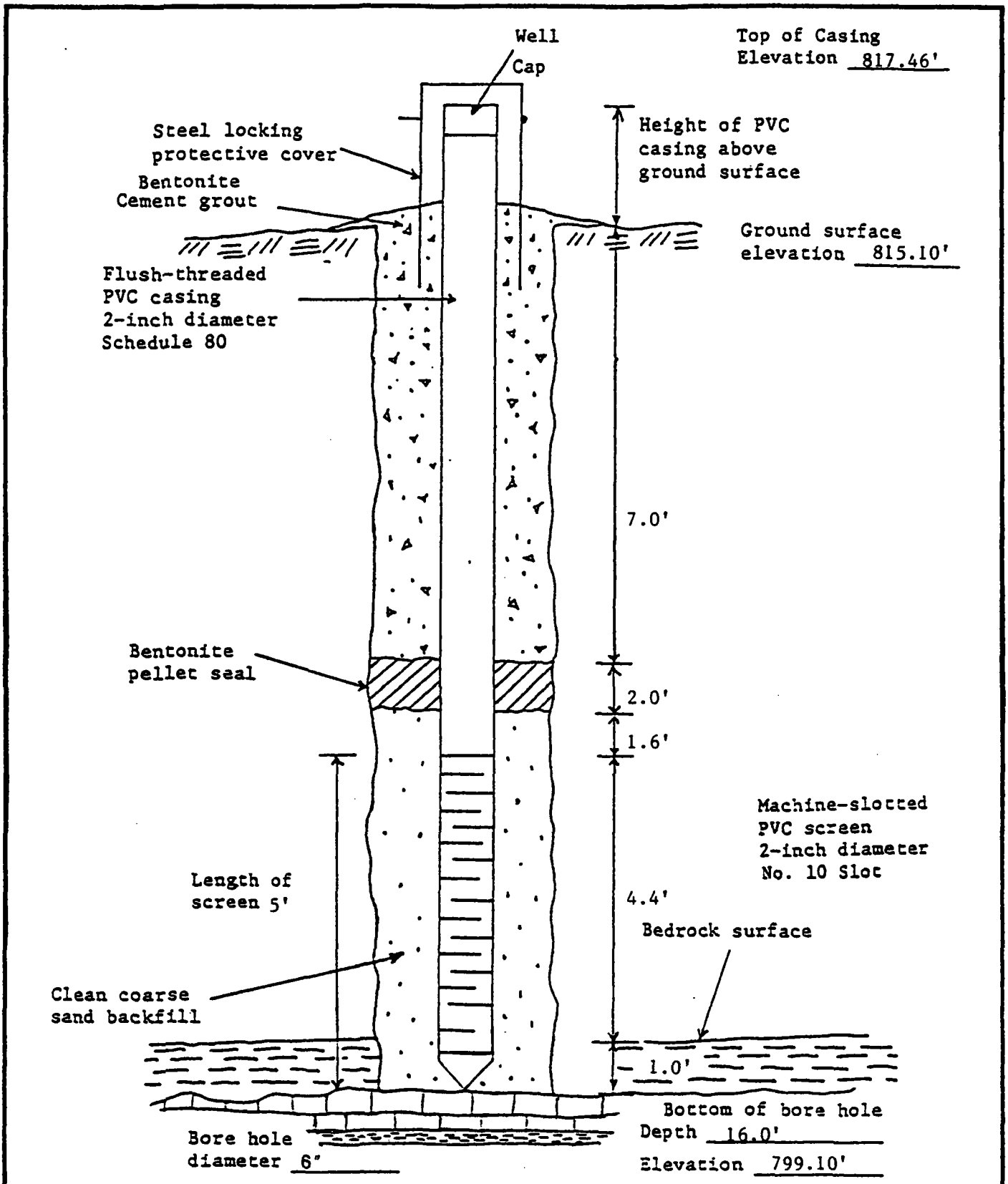


Figure II-21
MONITORING WELL CONSTRUCTION RECORD, MW-211

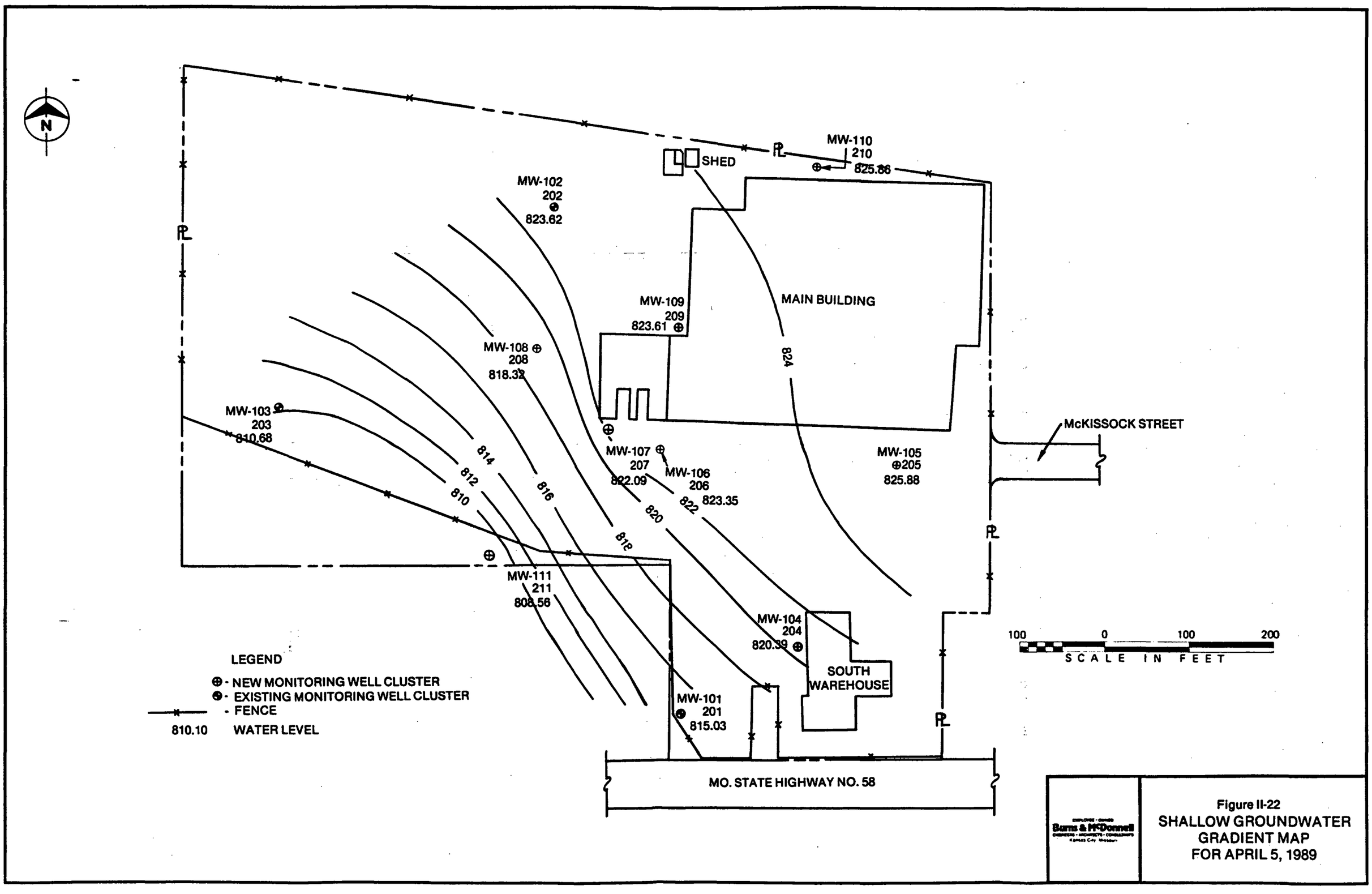
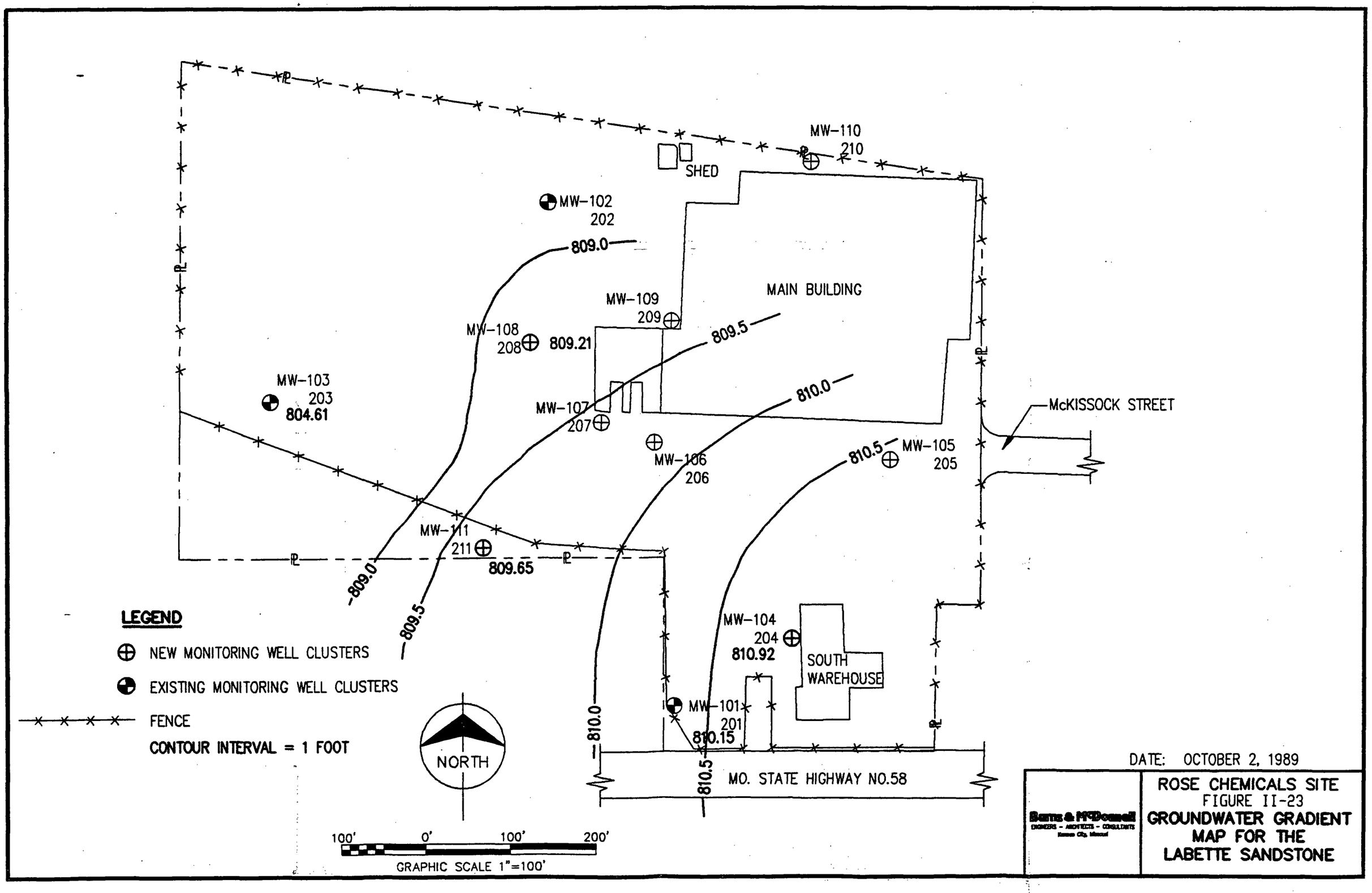


Figure II-22
SHALLOW GROUNDWATER GRADIENT MAP FOR APRIL 5, 1989



DATE: OCTOBER 2, 1989

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ROSE CHEMICALS SITE
FIGURE II-23
GROUNDWATER GRADIENT MAP FOR THE LABETTE SANDSTONE

ROSE04 1-25-90

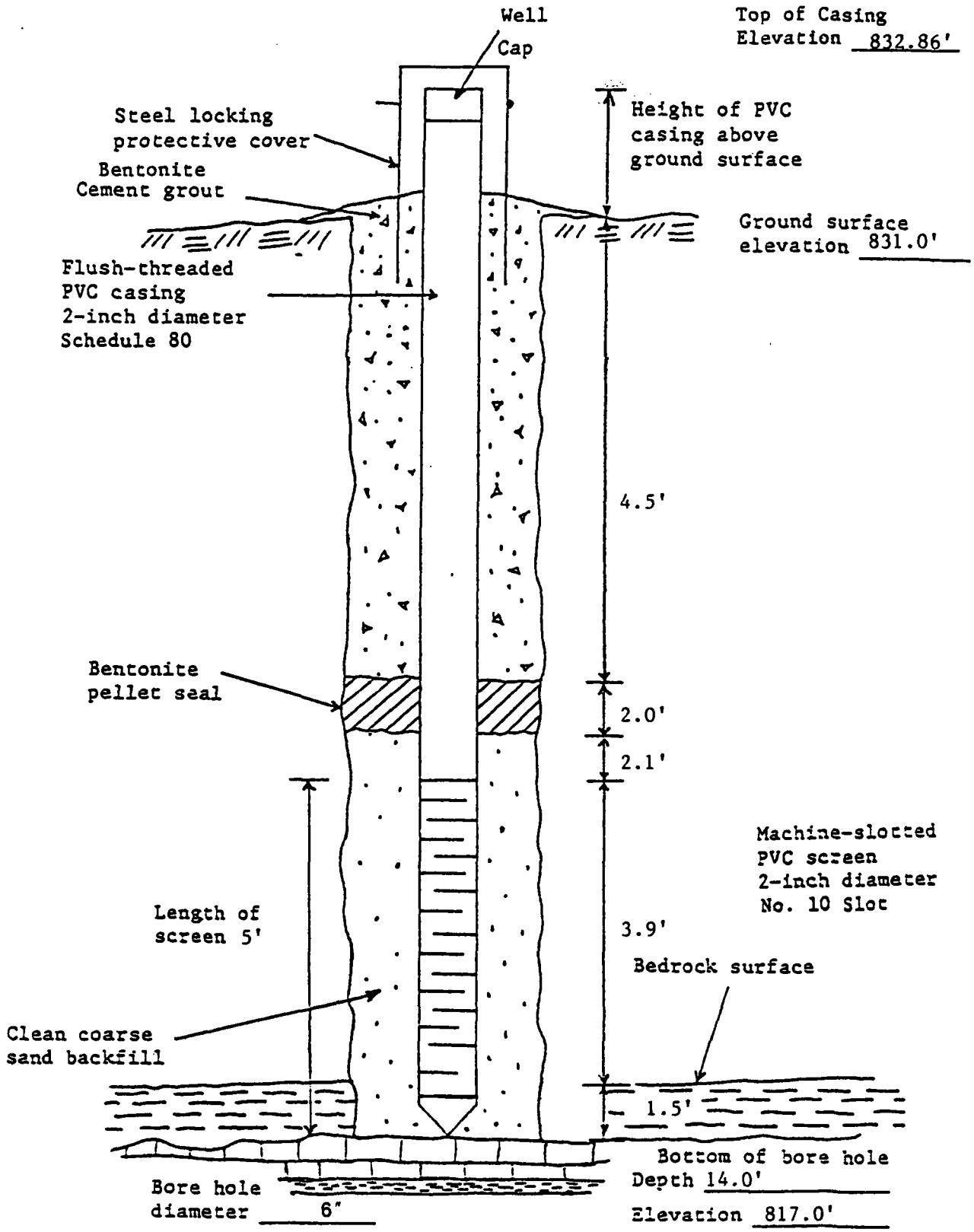


Figure II-16
MONITORING WELL CONSTRUCTION RECORD, MW-206

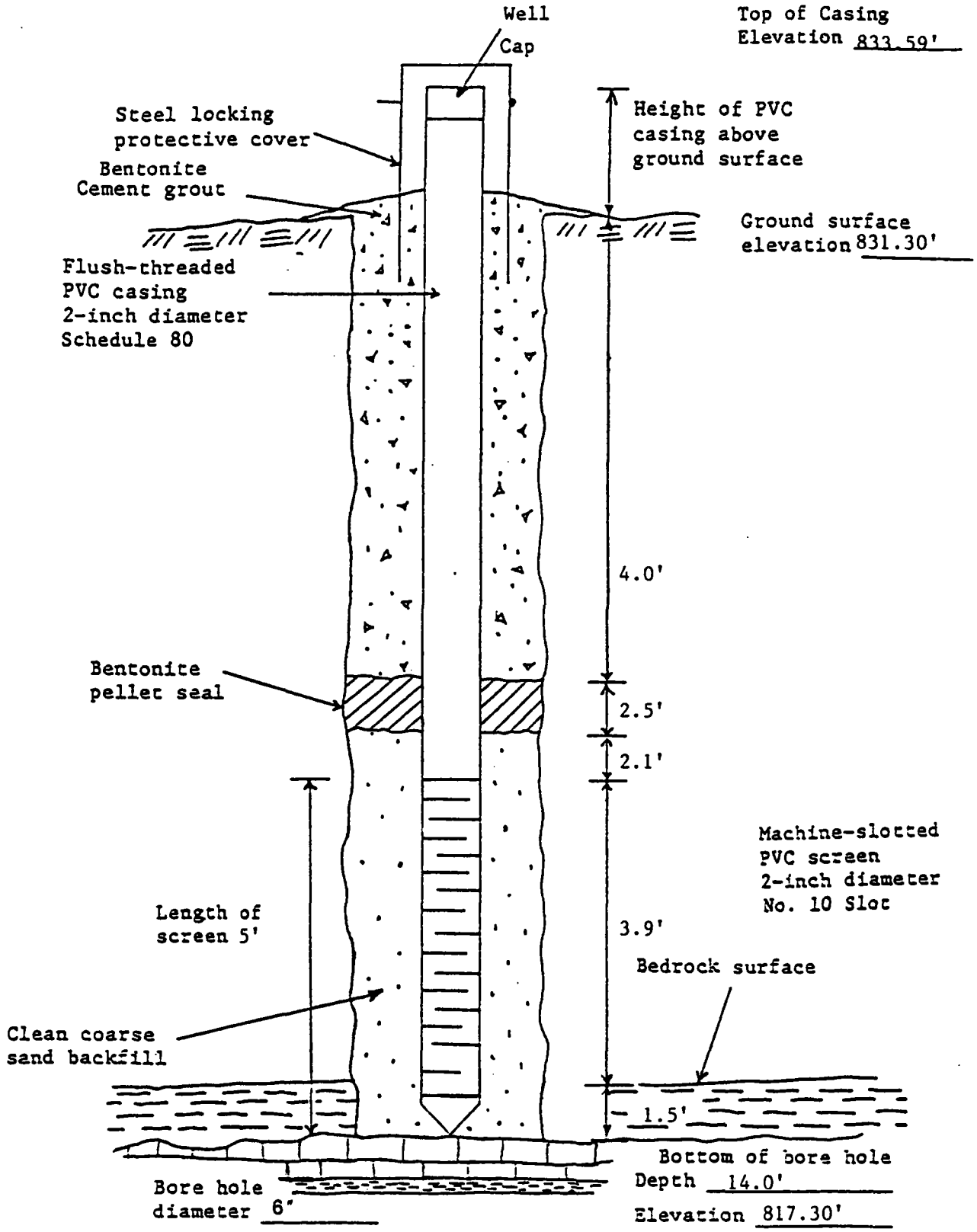


Figure II-17
MONITORING WELL CONSTRUCTION RECORD, MW-207

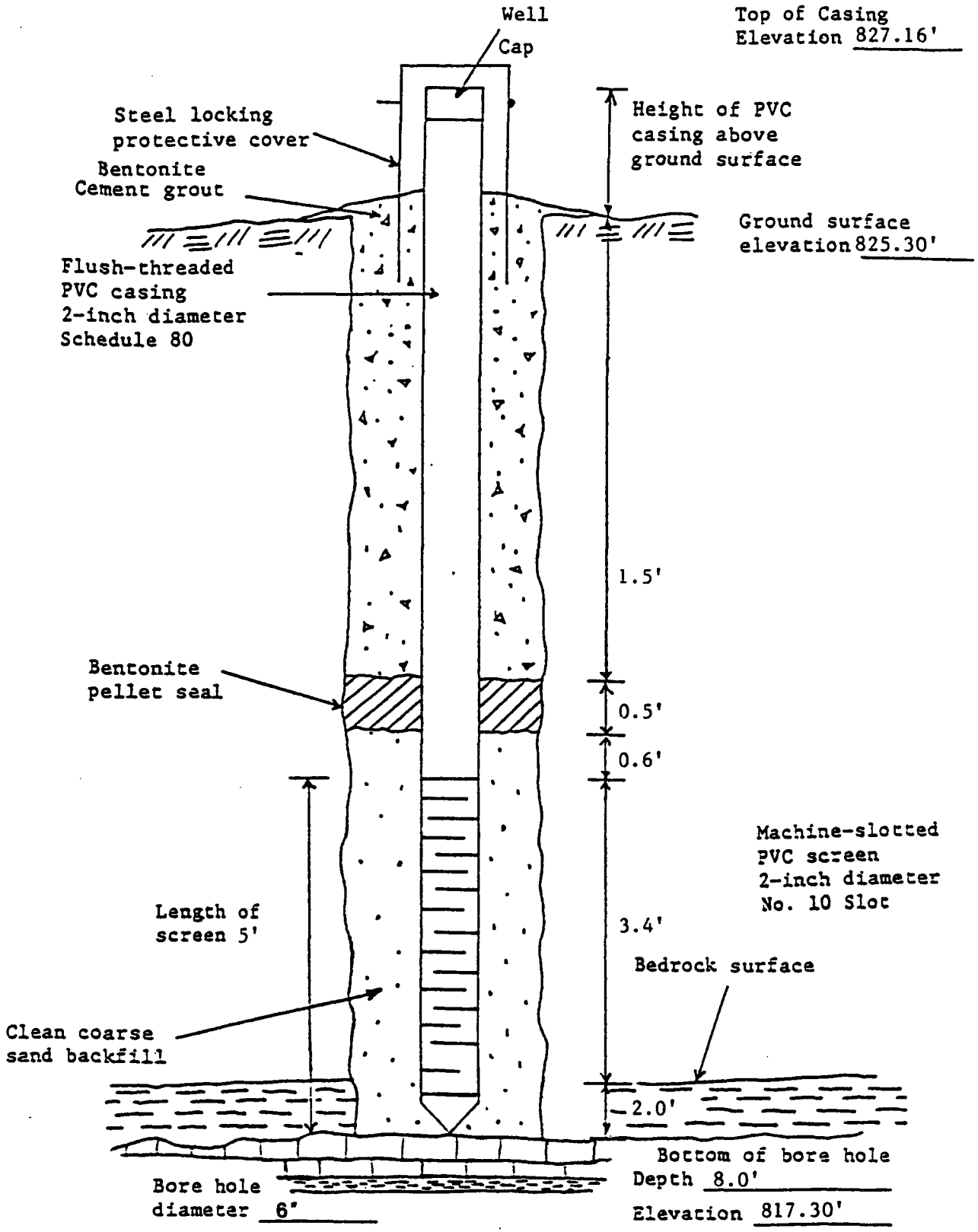
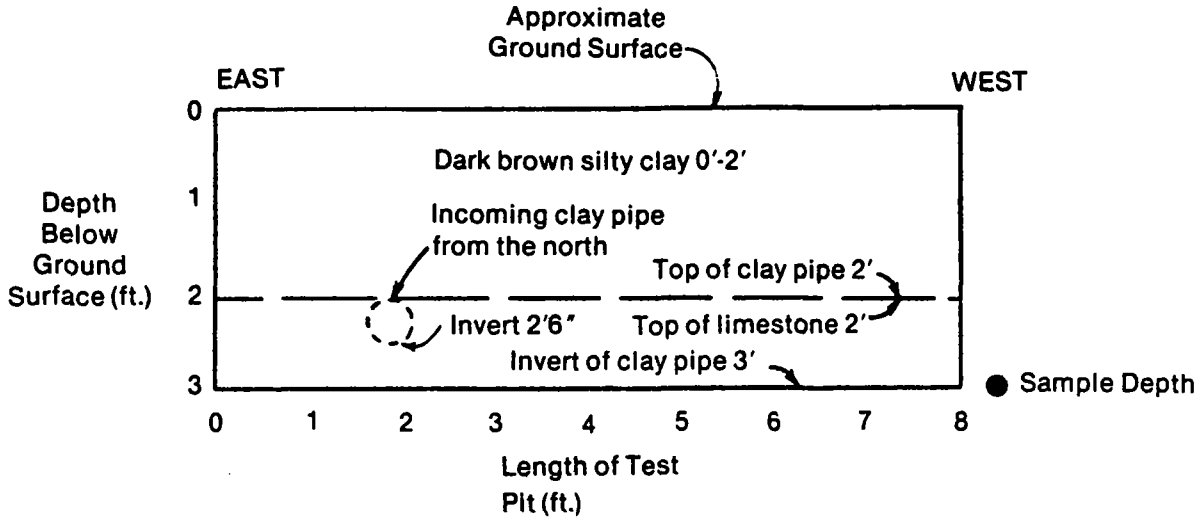


Figure II-18
MONITORING WELL CONSTRUCTION RECORD, MW-208



Notes:
1. Clay pipe is set flush into limestone. Top of rock and top of clay pipe both at 2'0".
2. The incoming clay pipe is from the manhole on the south side of the main building and is a dead line.
3. Trench dry at completion.
4. Hnu reading - 0.5 ppm of sample jar headspace.

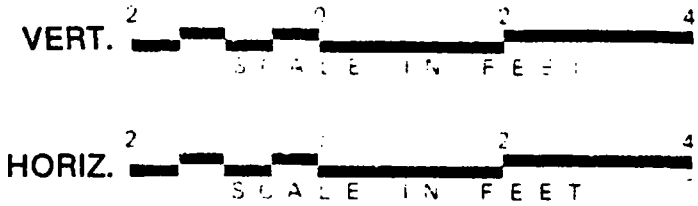


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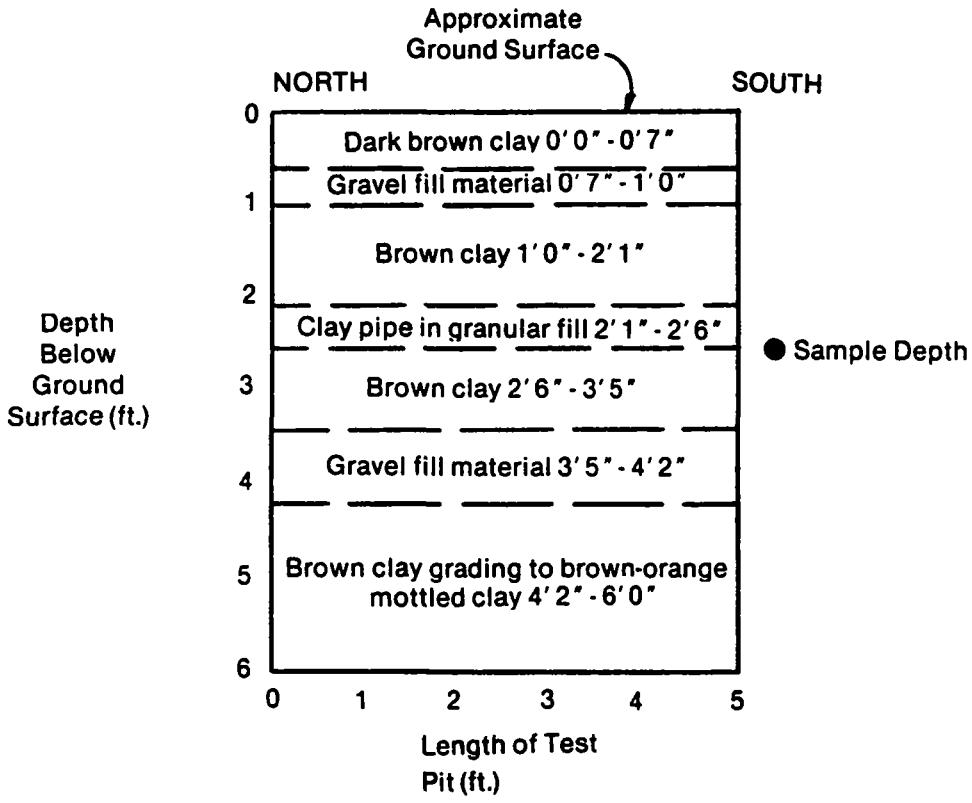
Figure III-1
PROFILE VIEW OF
TEST PIT NO. 1



Notes: 1. Trench dry at completion.
2. HNU reading of sample jar headspace - 0.2 ppm.

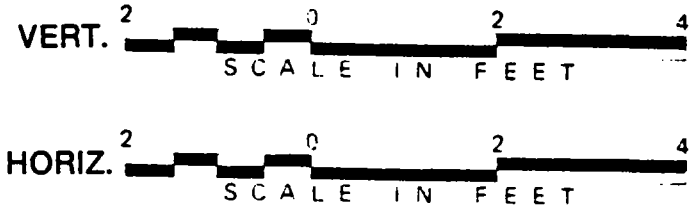


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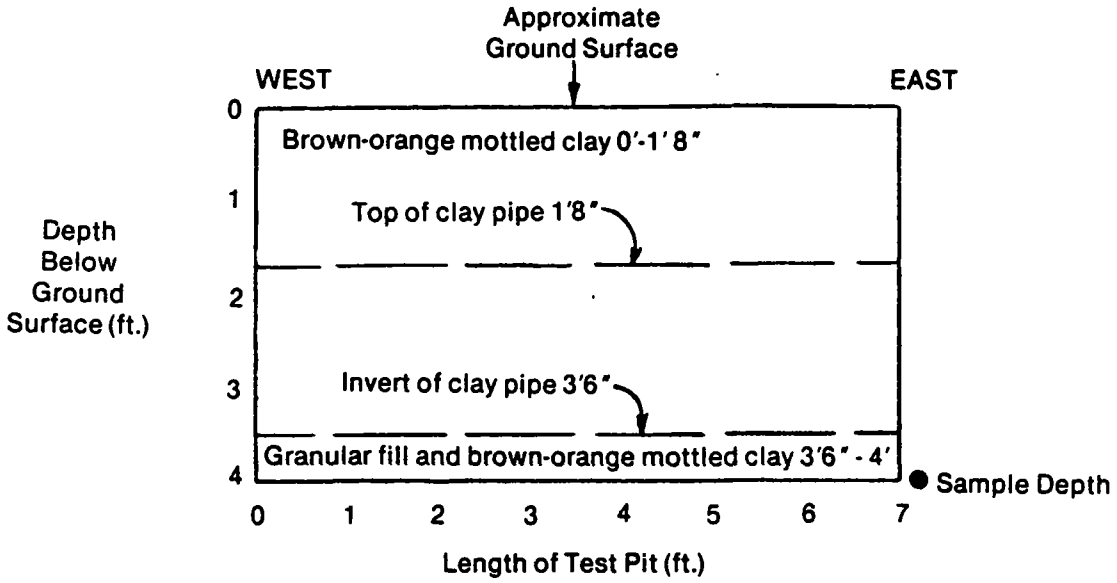
Figure III-2
PROFILE VIEW OF
TEST PIT NO. 2



Notes: 1. 2" of water in bottom of trench at time of completion.
2. HNU reading of sample jar headspace - 1ppm.

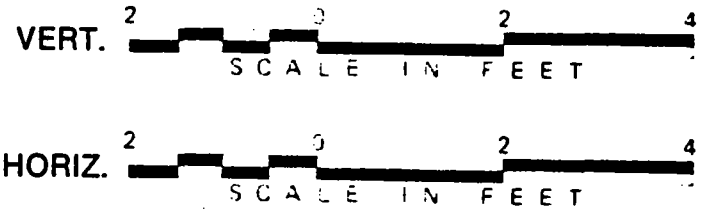


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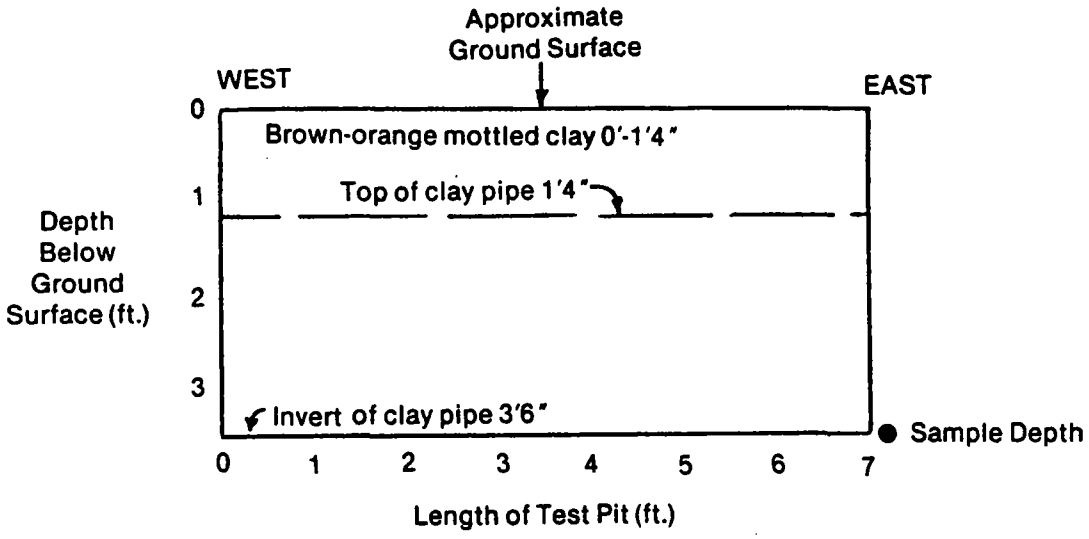
Figure III-3
PROFILE VIEW OF
TEST PIT NO. 3



Notes: 1. Dry at time of completion.
2. HNU reading of sample jar headspace - 13 ppm.

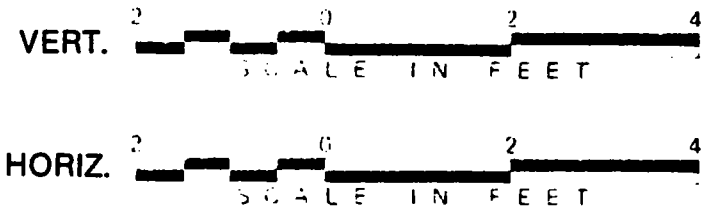


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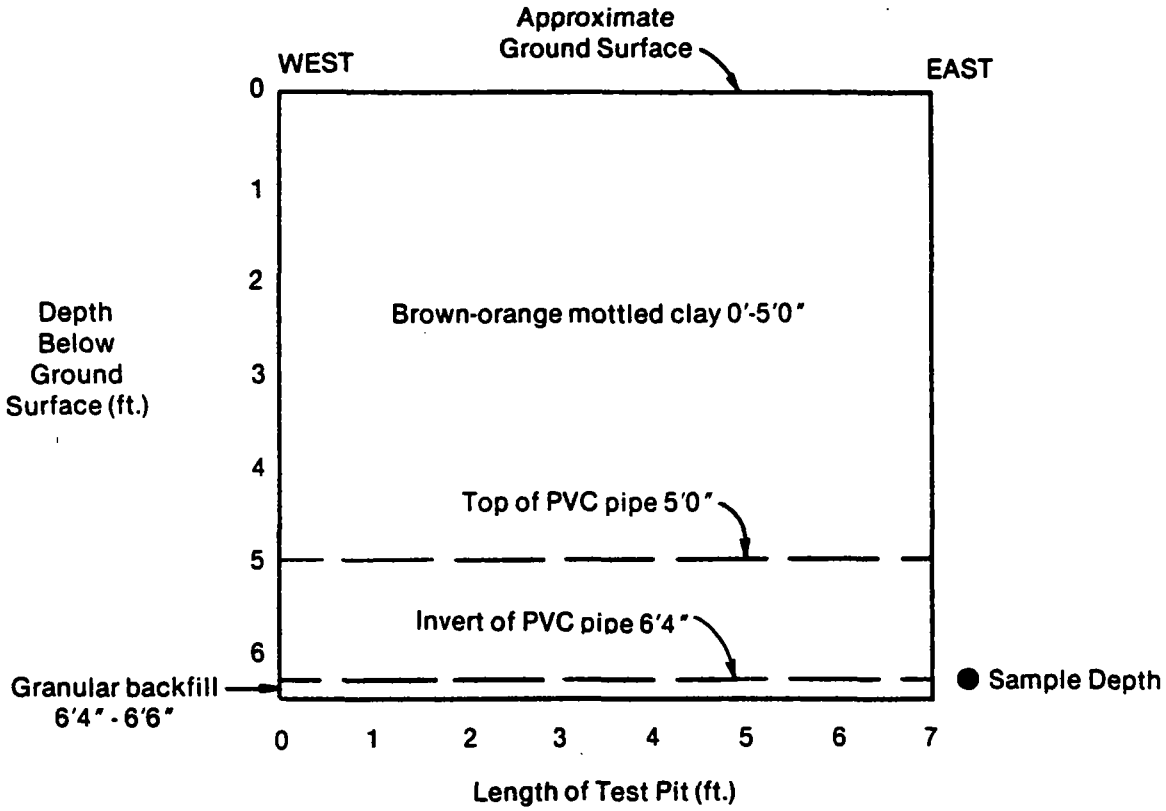
Figure III-4
PROFILE VIEW OF
TEST PIT NO. 4



Notes: 1. Water observed flowing through granualr fill at completion. Approximately 3" of water in granular fill at completion.
2. TIP reading of sample jar headspace - 8 ppm.

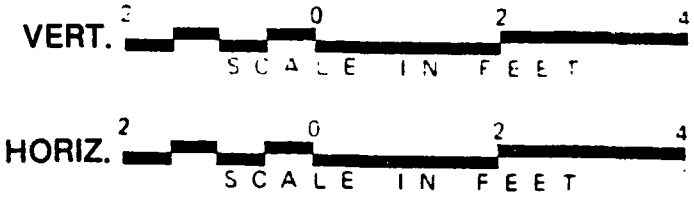


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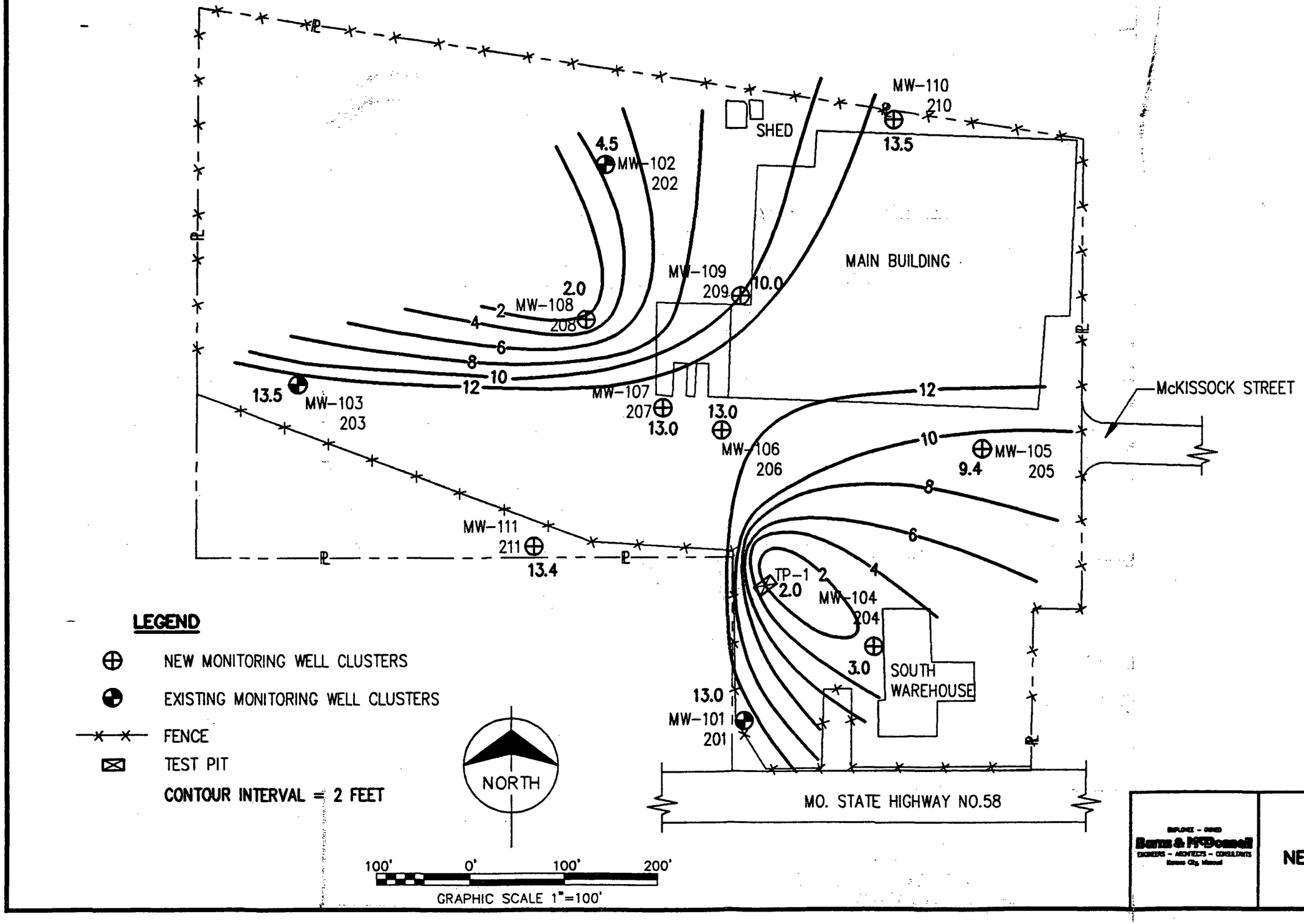
Figure III-5
PROFILE VIEW OF
TEST PIT NO. 5



ROSE32 7-31-89

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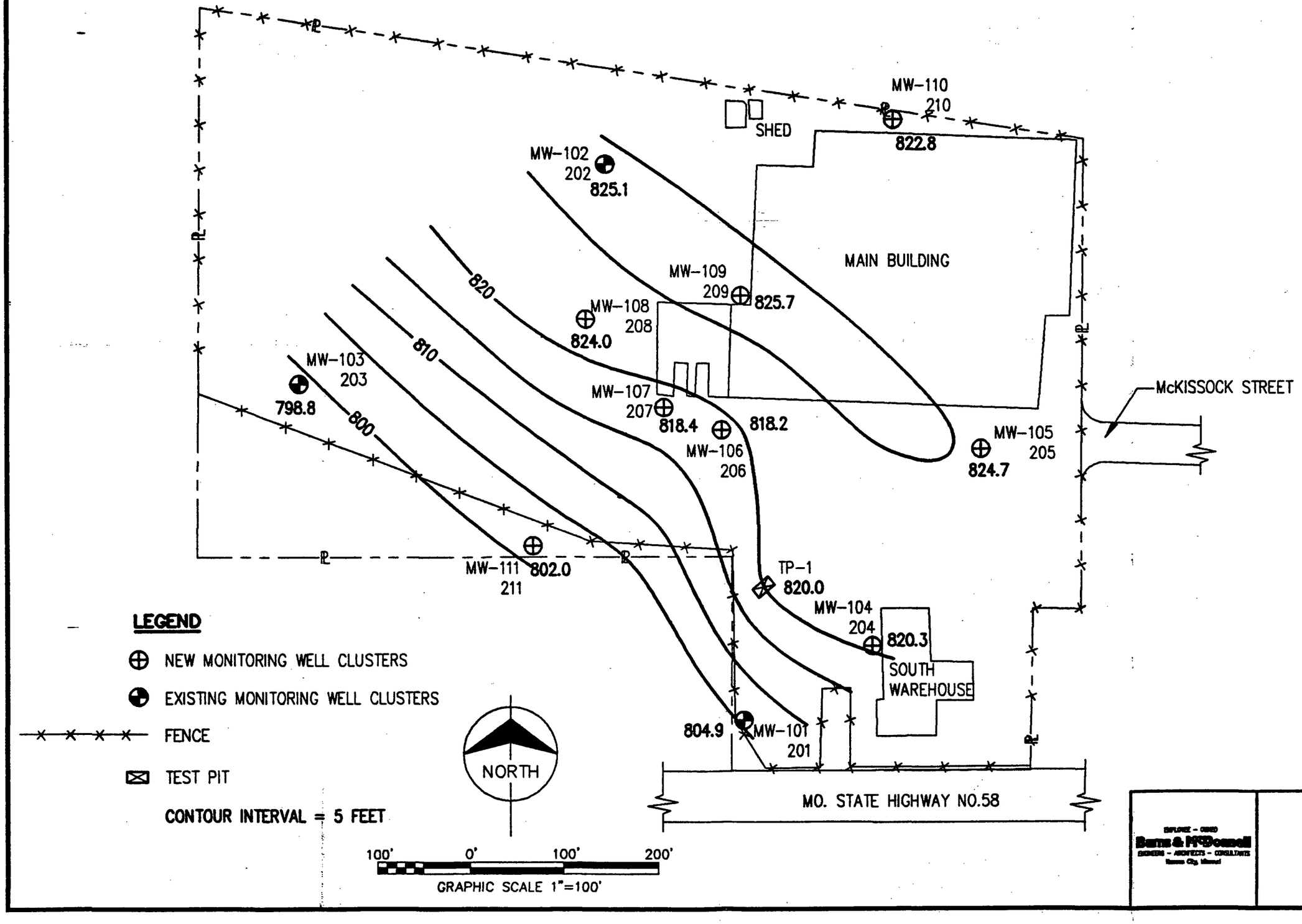
FIGURE IV – 1
NET SOIL THICKNESS



ROSE33 7-31-89

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Kansas City, Missouri

FIGURE IV – 2
TOP OF ROCK CONTOUR MAP

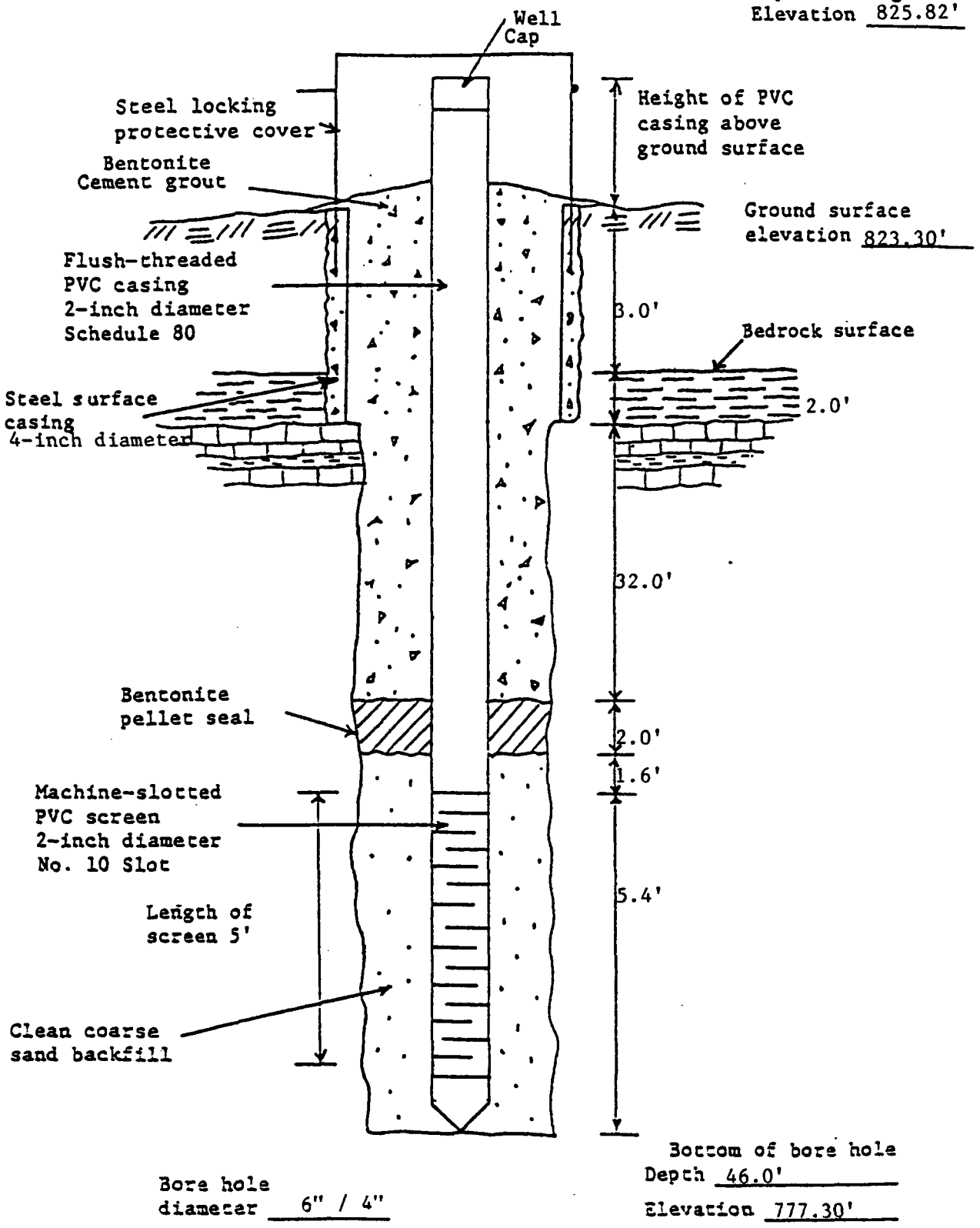


Figure II-6
MONITORING WELL
CONSTRUCTION RECORD,
MW-104

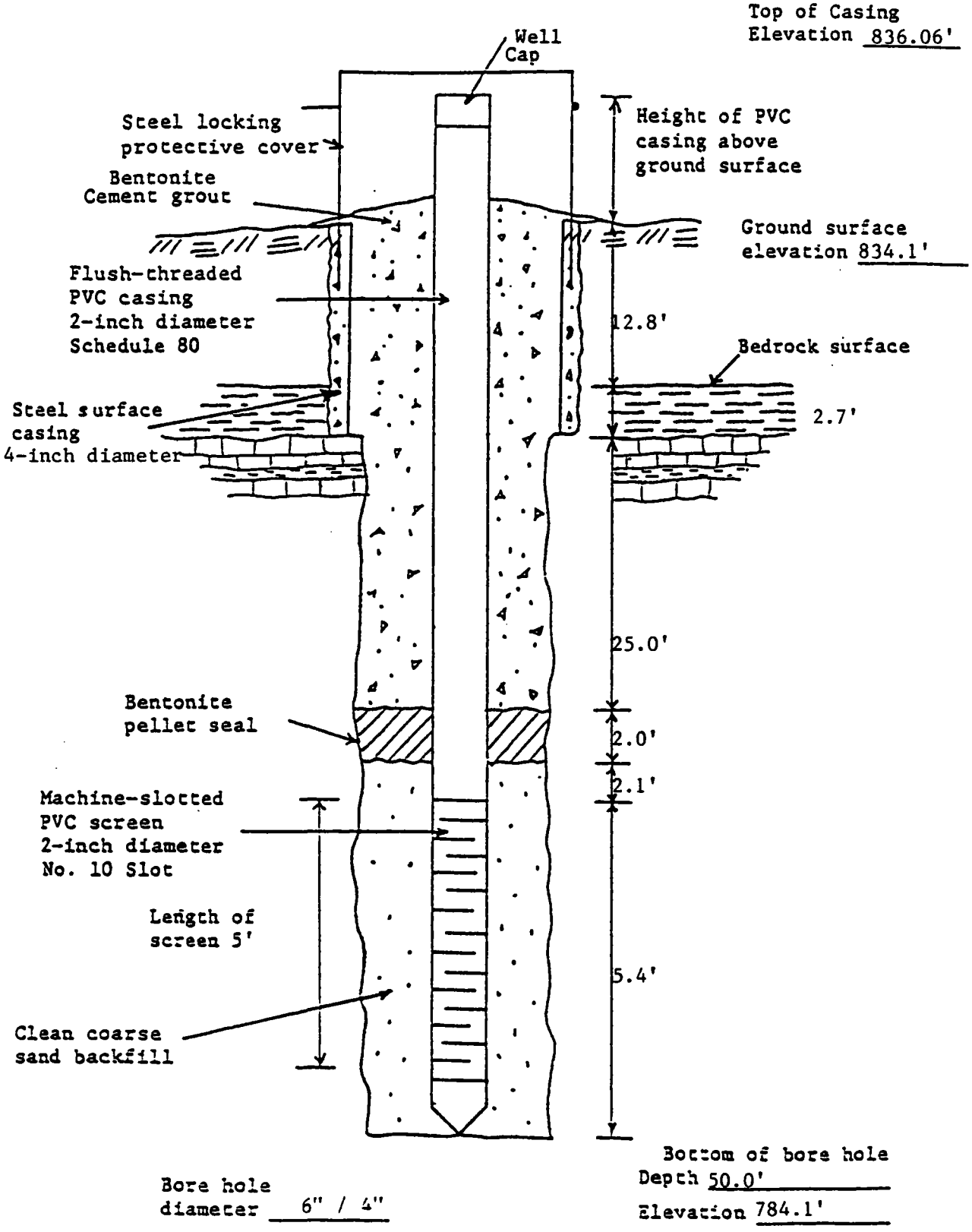


Figure II-7
MONITORING WELL CONSTRUCTION RECORD, MW-105

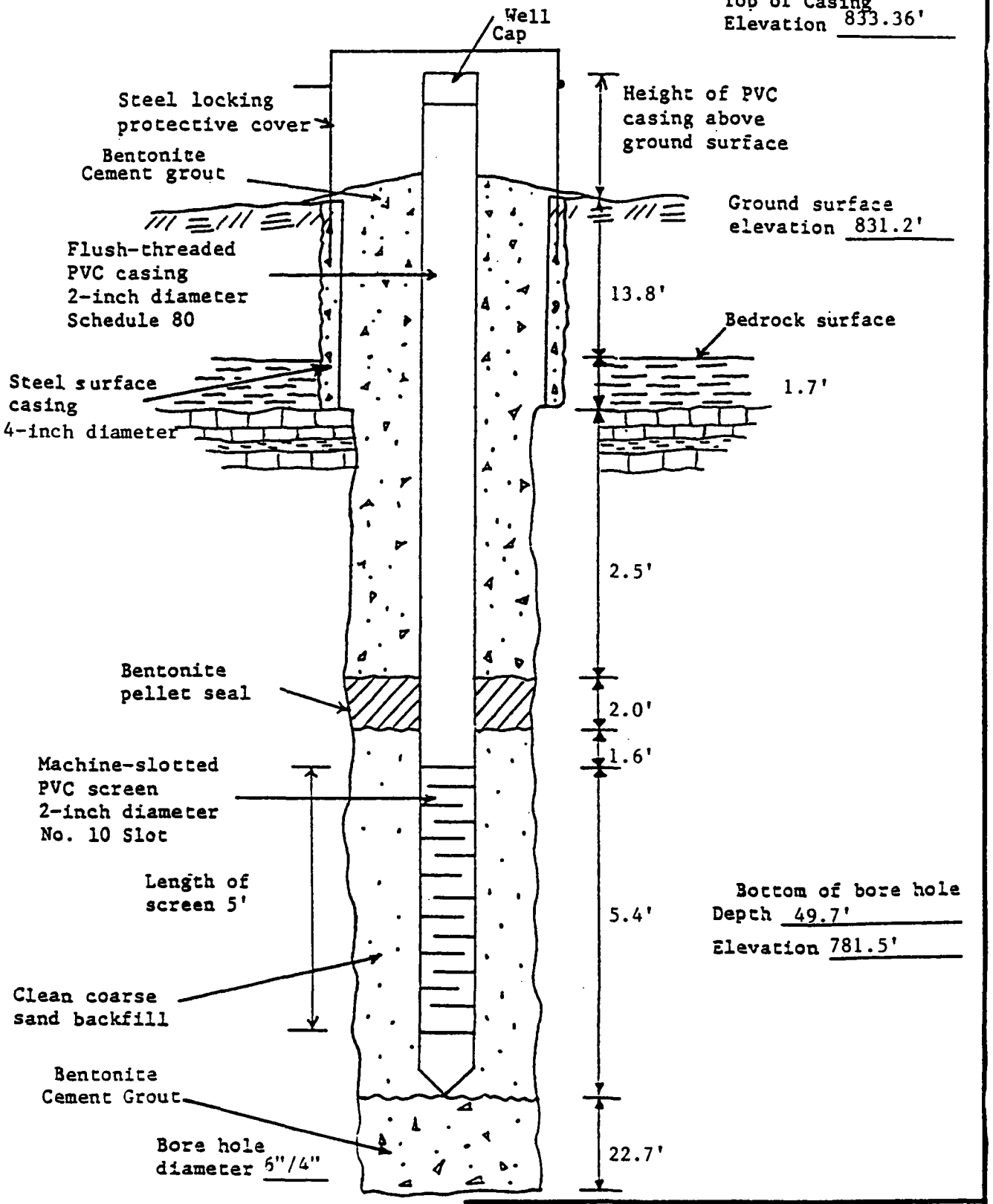


Figure II-8
MONITORING WELL CONSTRUCTION RECORD, MW-106

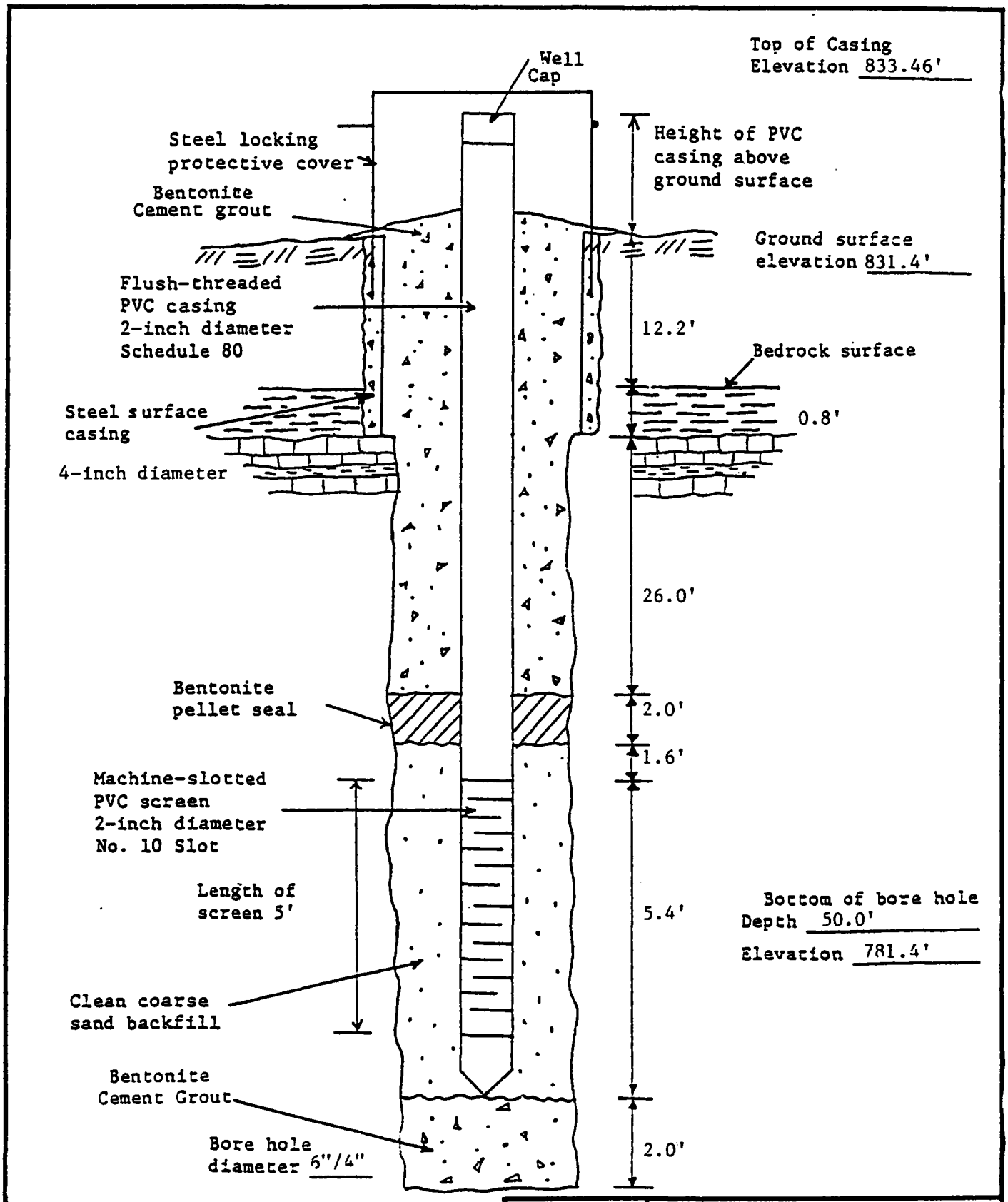


Figure II-9
MONITORING WELL
CONSTRUCTION RECORD,
MW-107

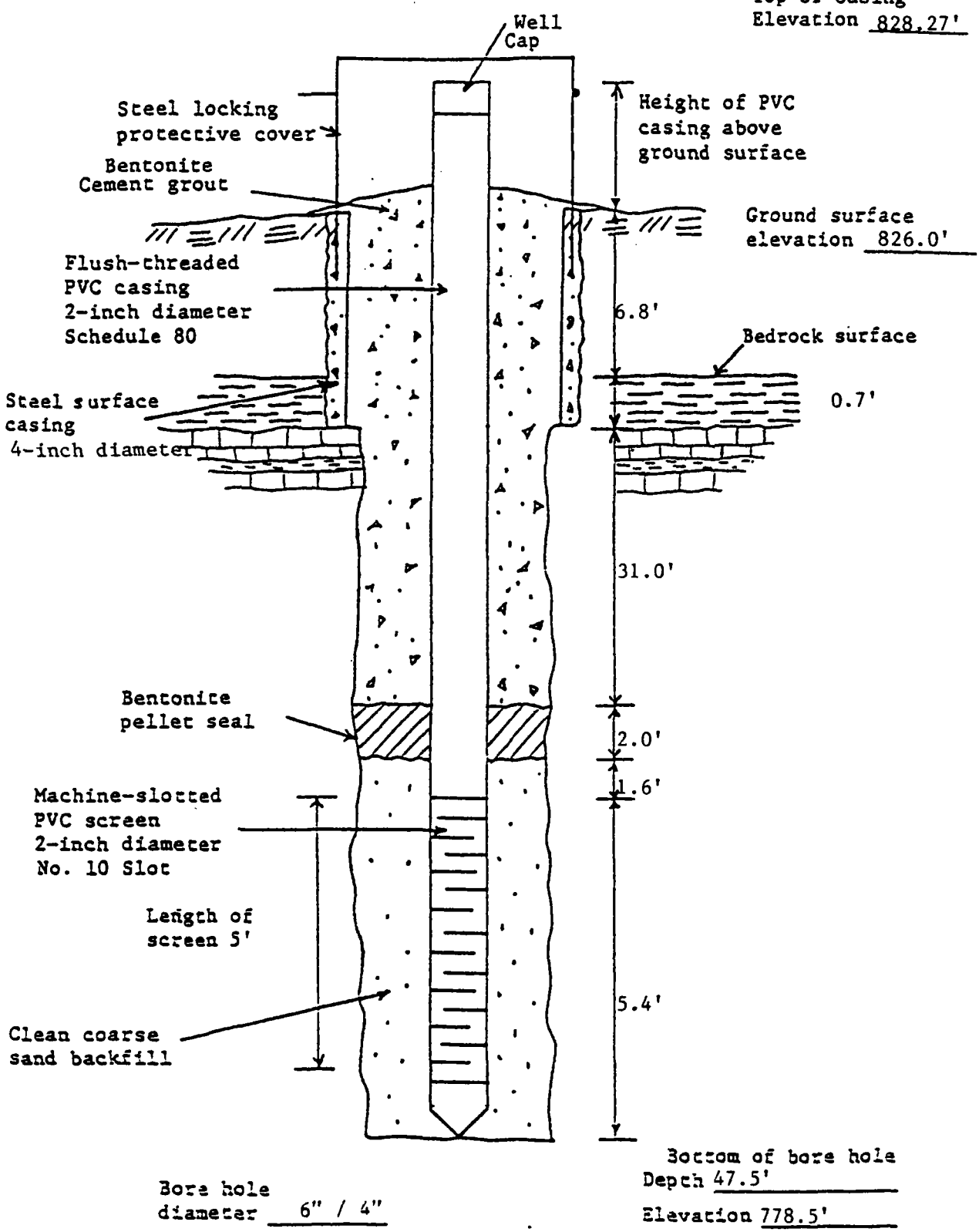


Figure II-10
MONITORING WELL CONSTRUCTION RECORD, MW-108

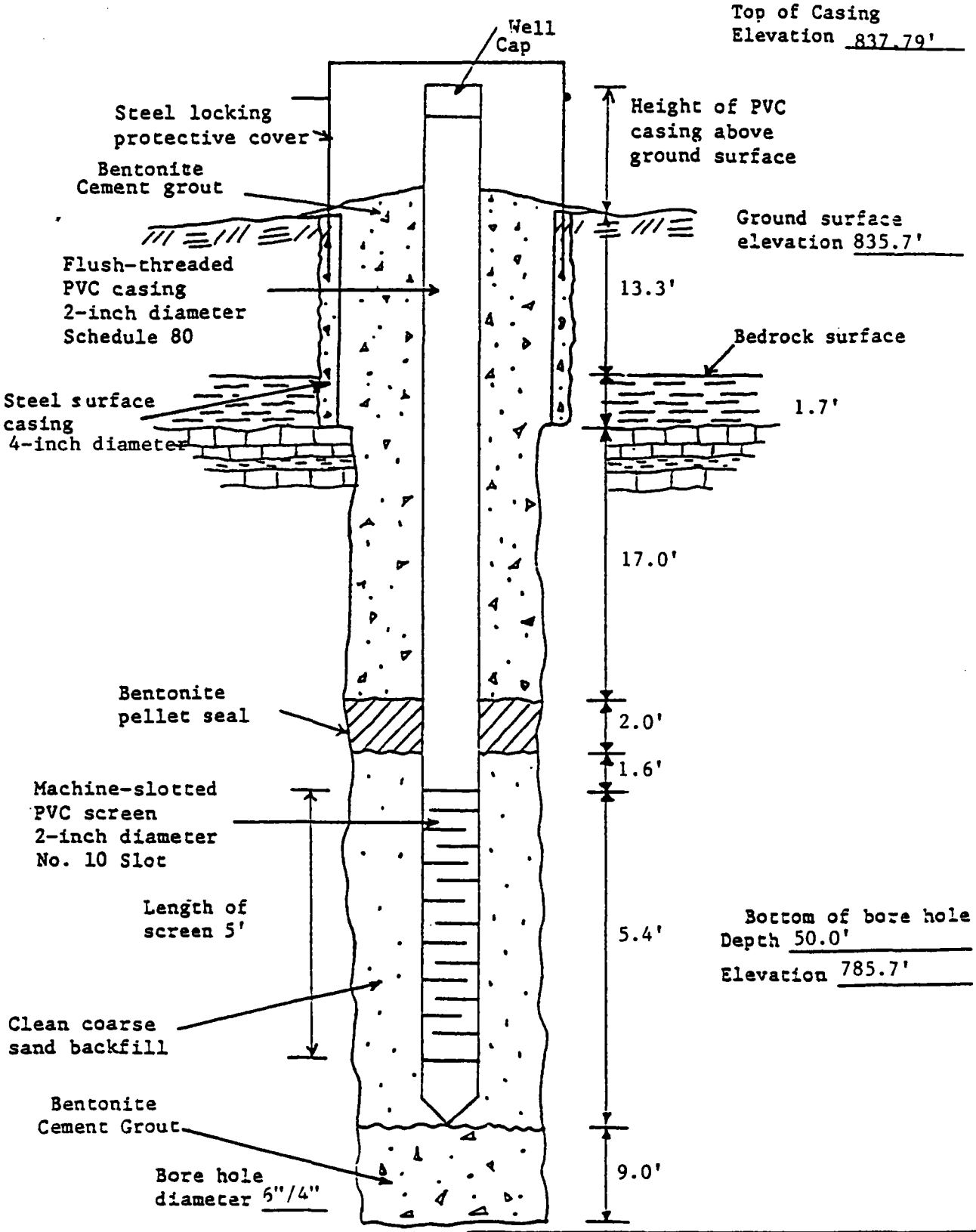


Figure II-11
MONITORING WELL CONSTRUCTION RECORD, MW-109

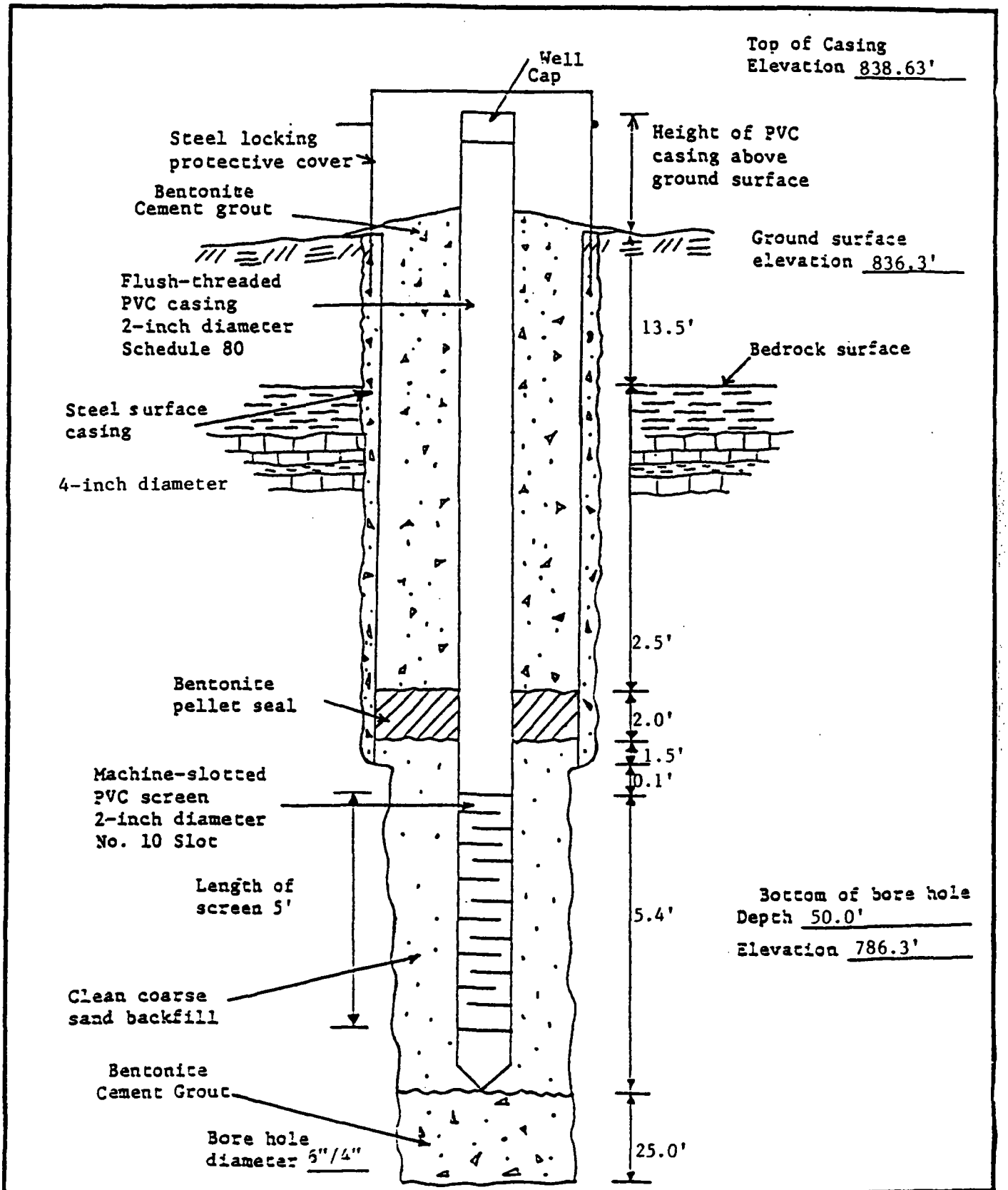


Figure II-12
MONITORING WELL
CONSTRUCTION RECORD,
MW-110

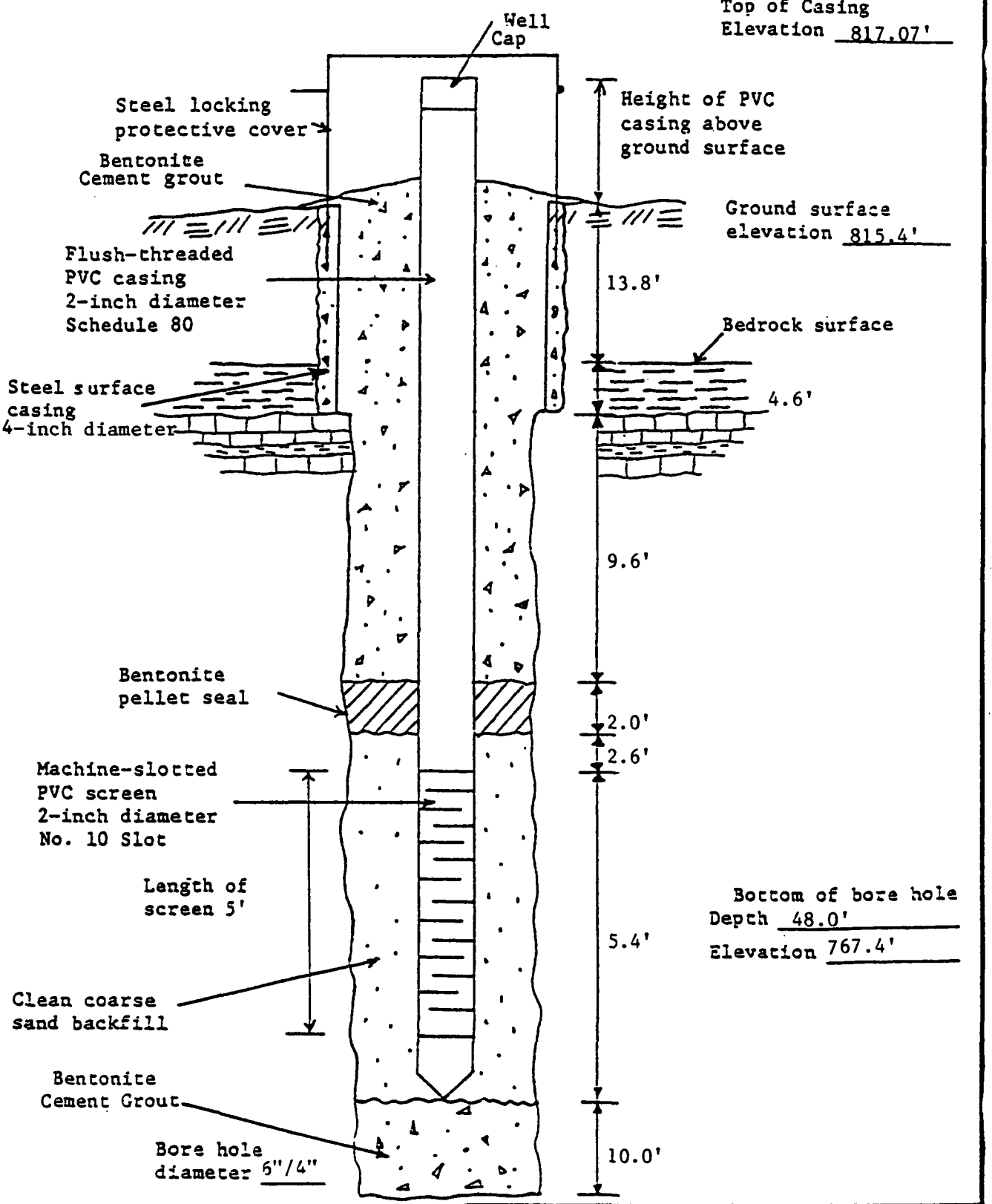


Figure II-13
MONITORING WELL
CONSTRUCTION RECORD,
MW-111

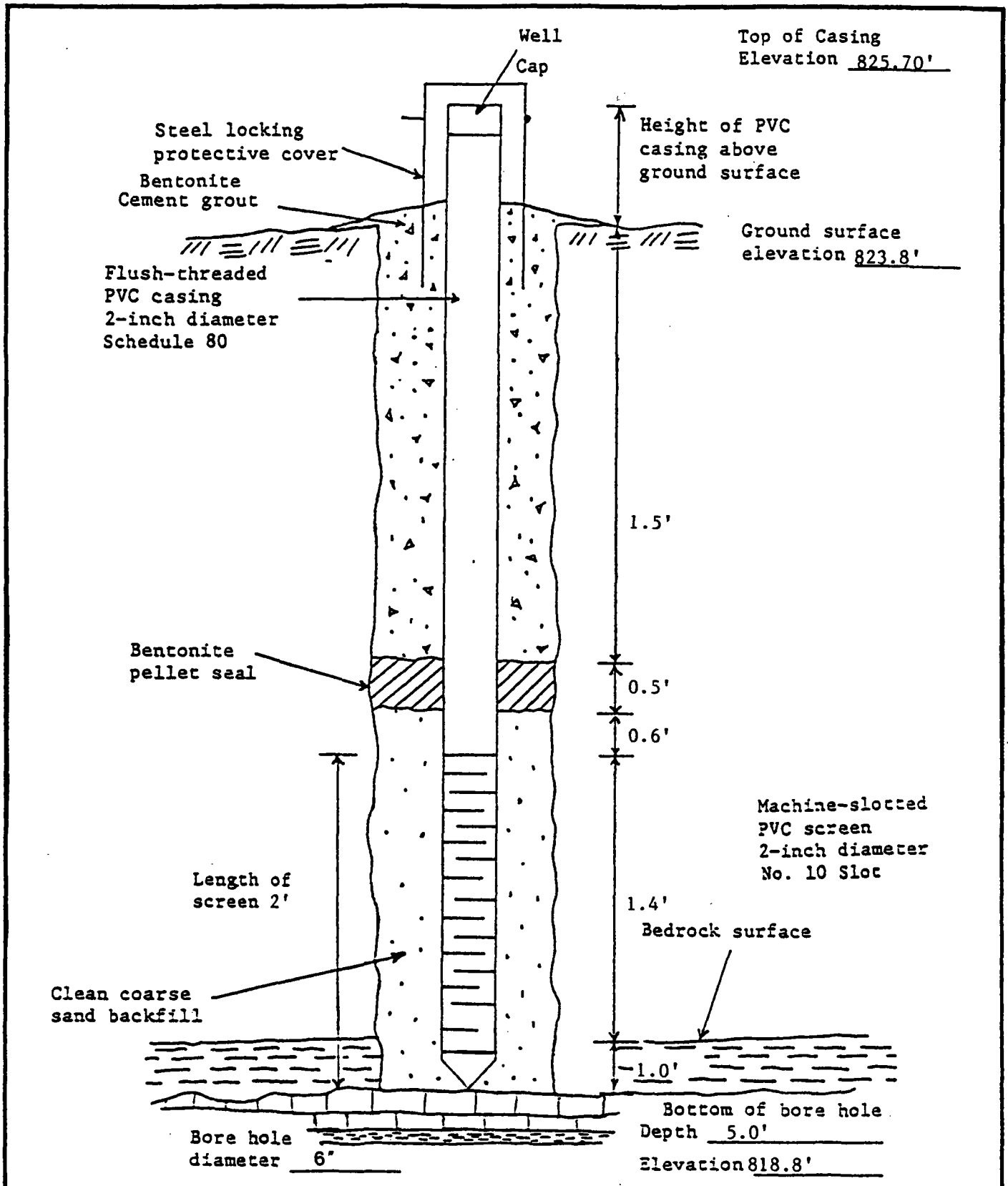


Figure II-14
MONITORING WELL CONSTRUCTION RECORD, MW-204

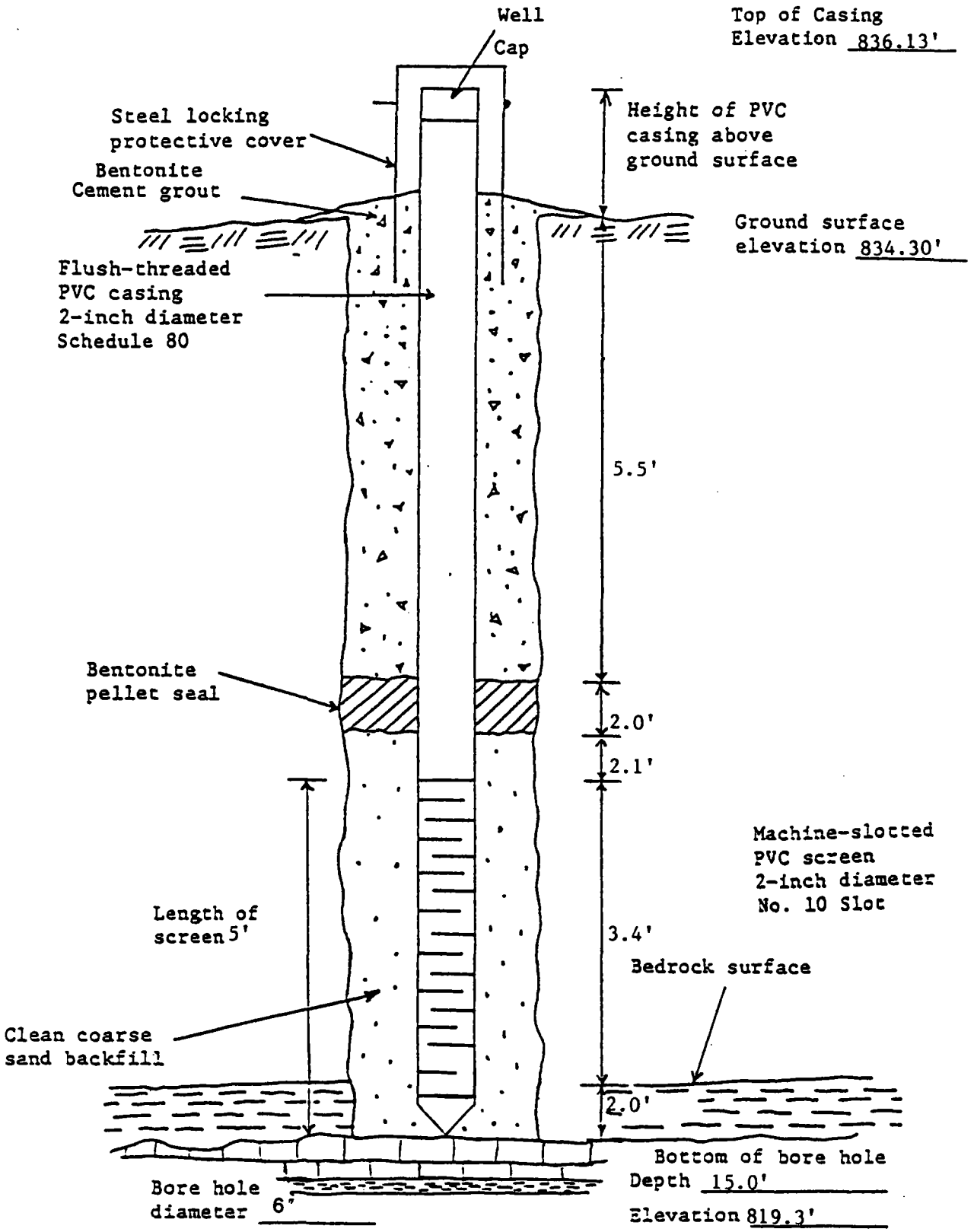


Figure II-15
MONITORING WELL CONSTRUCTION RECORD, MW-205

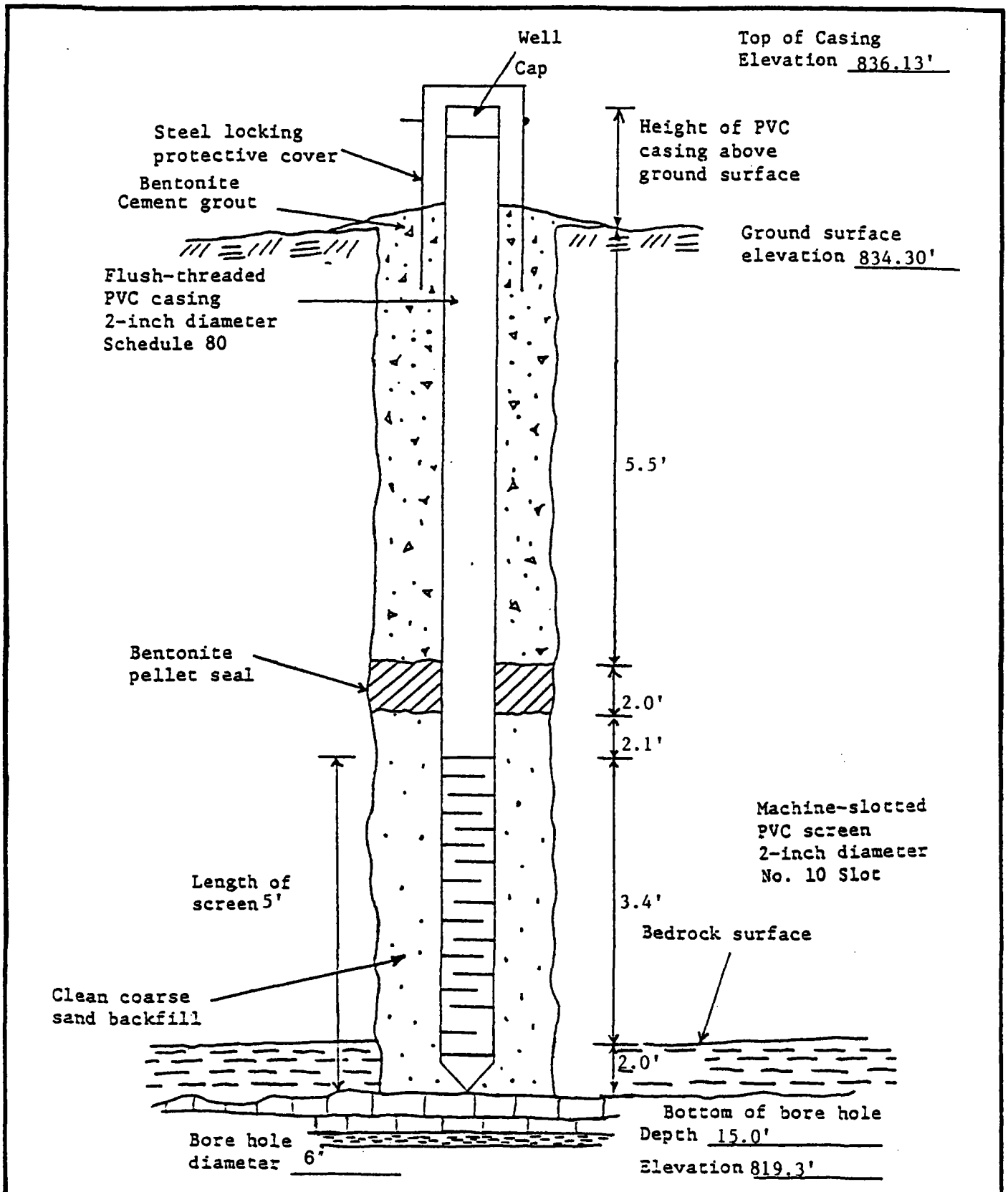
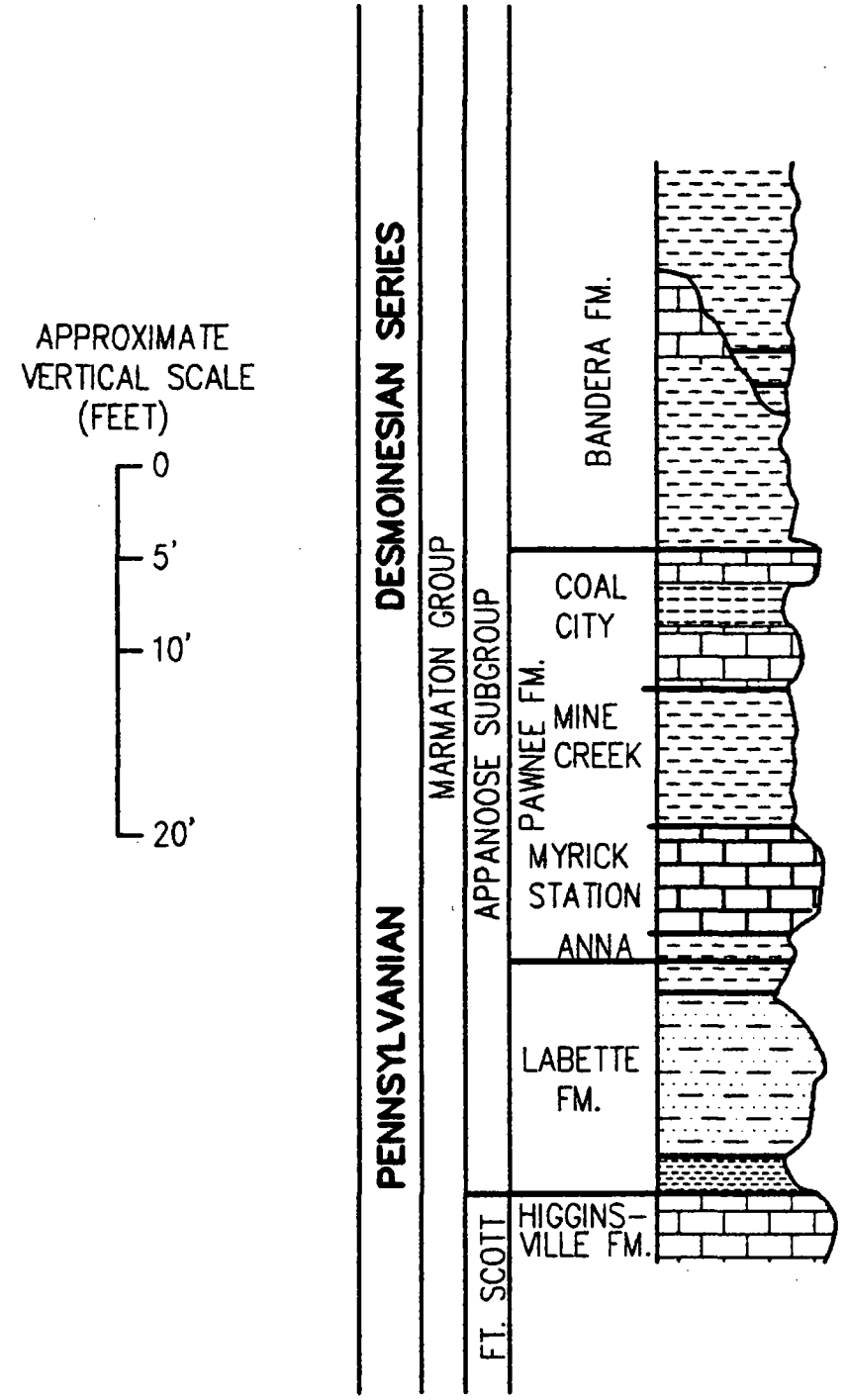


Figure II-15
MONITORING WELL CONSTRUCTION RECORD, MW-205



ROSE31.DWG 01-25-1990 16:08

EMPLOYEE - OWNED
Burns & McDonnell
ENGINEERS - ARCHITECTS - CONSULTANTS
Kansas City, Missouri

ROSE CHEMICALS SITE

FIGURE IV-3

STRATIGRAPHIC COLUMN

APPENDIX A - DRILLING LOGS FOR MONITORING WELLS

Doc. No. DL-13

Drilling Log

Project Name: ROSE CHEM						Boring No.: MW-104	
Project No.: 68-025-4						Page: 1 of 3	
Ground Elevation: 823.3'	Location:					Total Footage: 46' 0"	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
HOLLOW / NX	6"-4"	4' 6"	41' 6"	2	4	SEE REMARKS	

Drilling Co.: LAYNE Western Co.		Driller (s): RANDY CROWELL	
Drilling Rig.: MOBILE B-61		Type of Penetration Test: STANDARD	
Date: 1-6-89	To: 1-30-89	Field Observer (s): PAUL CLARK / CHRIS NEWELL	

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Monitor Tip Remarks
1	BROWN-GRAY MOTTLED CLAY; WET; STIFF; IRON STAINED; ORGANICS; TRACE GRAVEL		4/5/8/8	12/24		SS-1	START 1-6-89 @ 1PP SAMPLE: 1.6 ppm
2	DARK BROWN-GRAY MOTTLED CLAY; MOIST; STIFF						1 VOC FOR SS-1 1PP & SS-2 1PP
3	LIMESTONE IN SPOON BASE WEATHERED LIMESTONE IN SPOILS		9/22/32/1"			SS-2	TIP: 0 ppm @ WELL HEAD SAMPLE: 7.1 ppm 1PP AUGER. 1PP
4	FRESH LIMESTONE IN SPOILS						AUGER GRINDING LIMESTONE PIECES IN SPOILS. TIP: 13.0 ppm WELL HEAD
5	Gray conglomeritic limestone, fossiliferous, algal mound development		Core Length 2½" 2½"				AUGER REFUSAL @ 5.0' TIP: HEADTIP: 51.0 ppm (Auger not rotating)
6	Gray limestone, laminated, strong, fossiliferous		4" 5"				SS-2 SOLVENT ODOR
7			4" 6½"			BOX #1	REC. 3.5'
8	Light gray limestone, vugular, fossiliferous Light gray limestone, laminated, strong hard.		4" 3½" 8"				INSTALLED CASING & GRAVEL IN PLACE @ 5.0' No recovery from 8.4' to 9.8'
9						RUN #1	RUN 4.8'
10	Light gray limestone, laminated, dense, hard, trace of fossils		4½" 1"				REC 10.0'
11	Gray shale, moderately weathered laminated		13½" 19"				
12			11½"				
13			1"			RUN #2	RUN 10.0'
14	Gray Purple shale, very weathered, moderately strong to weak						

cont. DL-13

Drilling Log, continued

Boring No. MW-104

Project Name ROSE CHEM — Page 2 of 3

Project No. 88-025-4 — Date 1/17/89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
15	Gray shale, laminated, moderately strong		11" 7"		Box #1	Purple discoloration at 14.6' - 16.5'
16	Gray shale, weak, weathered, broken		2½" 5"			
17	Gray shale, laminated, moderately strong		15" 14"		Box #2 Run #2 Run 20'	
18						
19	Light gray limestone, strong, fossiliferous		11"			
20	Gray shale, weathered, platey, traces of limestone gravel		1" 2½" 5" 5½" 5" 3" 1½" 2½"			
21						
22						
23	Light gray limestone, with limestone inclusions and fossil hash		1" 4" 2" 1½" 17" 12"		Box #2 Rec. 10'	
24						
25						
26	Gray shale, very weathered, platey, weak, trace of limestone gravel.		7" 10½" 14"			
27			22"		Run #3 Run 10'	
28						At 28'2" purple discoloration.
29					Box #3	
30	Gray-purple shale, very weathered, medium to soft		3½ 3"		Run #4	

Cont: DL-13

Drilling Log, continued

Boring No. MW-104

Project Name ROSECHEM

Page 3 of 3

Project No. 88-025-4

Date 1/ /89

Depth	Description	Log or Class	Blow Count / Core Length	Core Recov. & Loss	Box or Sample No.	Remarks
32	Gray-purple weathered shale Gray shale, very weathered, moderately strong. Gradational boundary at base to a soft, gray, chloritic shale.		18" 15" 2"		BOX #3	
33						
34	Light gray limestone, strong, vugular, traces of crinoid stems.		4" 4" 1" 3"			Vugs filled in with chloritic clay.
35			3" 5"			
36	Light gray limestone, massive, strong, fossiliferous in places.		2½" 2½"		RUN #4 REC.	
37			10" ½"			
38			28" 5" 9"			
39			4"		RUN 5'	
40						
41	Light gray limestone interbedded with dark gray shale, fossiliferous, highly disturbed bedding.		3" 15"		RUN #5 REC 5.6'	
42	Dark gray shale, weathered, lenticular bedding, highly fossiliferous.		3"			
43	Gray shale, very weak, massive, grading into gray shale with sandstone lenses.		13"			
44	Gray sandstone, very fine grain, well consolidated, trace of biotite, detrital muscovite, intermittent shale lenses.		11" 2½" 2" 1½"		RUN 5.6'	Limestone lenses
45			1" 3½"			Flushed hole till clean 1¼"-1.0 Conducted 4 packer tests, bentonite cement grout to surface
46	Total Depth 46'0"		3" 5" 4"		1/3	Reamed boring & Installed 5' of 0.01" slotted screen to 46.0' Gravel packed to 39.3' Bentonite Pellets to 37.0'
47					1/3	Cement Bentonite Grout to surface

Drilling Log

Doc. No. DL-14

Project Name: ROSE CHEM						Boring No.: MW-105	
Project No.: 88-025-4						Page: 1 of 4	
Ground Elevation: 834.1'	Location:					Total Footage: 50'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
AUGER/NX	6" to 4"	13'	37'	7	3	SEE REMARKS	
Drilling Co.: LAYNE Western Co.					Driller (s): RANDY GREISEL		
Drilling Rig.: MOBILE B-61					Type of Penetration Test: STANDARD		
Date: 1-7-89	To: 1-26-89				Field Observer (s): PAUL CLARK / GREG NIEMAN		

Depth	Description	Sieve	Blow Count	Recov.	Sample or Box No.	Remarks
	ASPHALT & ROAD BASE (GRAVEL-CLAY-SILT)					START 1-7-89 10[illegible]
1	BROWN-GRAY SILTY CLAY; DRY TO DAMP; SOME SAND & GRAVEL.		5/11/8	6/18	SS-1	AUGER THRU ROAD BASE BORE HEAD: 0 ppm SAMPLE: 3.2 ppm
2						10[illegible]
3			8/12/17/17	1/24	SS-2	NO SAMPLE TAKEN
4	GRAY TO RUST CLAY; MOIST IN TIP OF SPOON					AUGER TO 4' 10[illegible]
5	DARK BROWN SILT; DRY BROWN-GRAY MOTTLED CLAY; STIFF IN PART; BLACK FLAKES THROUGHOUT		3/5/8/12	7/24	SS-3	BORE HEAD: 1.3 ppm SAMPLE: 2.1 ppm
6	DARK BROWN CLAY & SILT IN TOP					11[illegible]
7				24/24	ST-1	11[illegible] TO 11[illegible] SHELBY TUBE PUSHED EASY
8	RUSTY BROWN LAYERED CLAY; IRON STAINED; DRY					AUGERED DOWN 11[illegible]
	BROWN-GRAY MOTTLED; SILTY SHALEY CLAY; DRY		10/26/50@5"	18/24	SS-4	BORE HEAD: 0 ppm SAMPLE: 2.2 ppm 11[illegible]
9	WEATHERED GRAY-BLACK MOTTLED SHALE					AUGERED DOWN 11[illegible]
10	BROWN WEATHERED GRAY SHALE; DRY LIMONITIC IN PART		20/48/50@5"	17/24	SS-5	BORE HOLE: 0 ppm SAMPLE: 1.2 ppm
11	GRAY WEATHERED FISSILY SHALE GRAY WEATHERED LIMONITIC SHALE		20/50@4"	9/11	SS-6	11[illegible] BORE HEAD: 0 ppm 13[illegible] SAMPLE: 2.3
12	AS ABOVE		36/50@5"	11/11	SS-7	AUGER TO 12' 12[illegible] BORE HEAD: 10.0 ppm 13[illegible] SAMPLE: 7.2 ppm AUGER TO 15.5' 1[illegible]
13	GRAY SHALE IN TIP OF SPOON (UNWEATHERED)					
14						

MONITOR: TIP II

cont: DL-14

Drilling Log, continued

Boring No. MW 105
Project Name Rose Chem
Page 2 of 4
Project No. 53-025-4
Date 1-7-89 & 1/19/89

Depth	Description	Log or Class	N Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
15	GRAY SHALE					PLUG CASING & GROUT @ 15.5' STOP AUGER 1-7-89 1530
16	Weathered Blk. Carboniferous Shale, abundant plant fragments, coal in places		3" 1" 3" 2½"		Box #1 Run 4.5' Recovered 3'	Start 1/19/89 at 1:00p Begin Run 1 @ 1:20p
17			5"			
18	Coal, Strong		1" 1" 2" frags			
19						
20	Carboniferous shale interbedded with gray clay, shale - weathered w/ plant fragments/coal. Coal		3" 4" 4" 4"			End Run 1 @ 1:40 Start Run 2 @ 1:45
21	Med grey, weathered shale w/ abundant gravel & gravel seams. Gravel ranges from 1" to ½" with a medium size of ¼". Weak		2" 9"		Box #1 Run 10' Recovered 7'10"	Took some water at 21'
22			10" 11" 6"			
23			9" 2" 5"			
24			11"			
25						
26						
27	Weathered grey shale, platey		17" 4" 2" 1"			
28					Box 2	
29	Lost during drilling					
30	Dk. grey, moderately Strong. Laminar Shale.		3" 4½"			End Run 2 @ 2:30 Start Run 3 @ 2:45

cont: DL-14

Drilling Log, continued

Boring No. MW-105

Project Name RoseChem

Page 3 of 4

Project No. 88-025-4 Length Core

Date 1/19/89

Depth	Description	Log or Class	N Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
			10"			fossiliferous in lower 6"
32	Lt. grey fossiliferous limestone. mottled appearance		11"		Box 2 Ran 6' Recovered 6'	
33	Massive, dk. grey, highly weathered shale, moderately strong.		16"			
			6"			
			3"			
34			2"			
35	Dk. grey Shale, weathered, fossiliferous, gravel.		3" fragments			finish run 3 @ 3:20
36	Lt. grey Limestone, mottled, fossiliferous		12"		Box 2 Ran 9'2" Recovered 9'2"	start run 4 @ 3:50
37			17½"			
38	Green-grey Shale, weathered, lenticular bedding. Ls. inclusions		1½"			
39	Black Shale, laminar. weathered, carboniferous		4"			
	Dk grey shale, weathered, limestone inclusions, carboneous		6½"			
40	Shaley limestone, lt. gry,		10"			
			1"			
41			6"			
	Grey shale, weathered, limestone inclusions, platey		1½"			
			2"			
42			6½"		Box 3	
			2"			
43			7½"			
			4½"			
44			2"			
			1"			
			1"			
45			2'5"			finish @ 5:30 PM 1/20/89 run 5
46	Core not recovered during drilling				Box 3 Ran 4½' 3'11" Recovered	start at 8:20 p 1/20/89 Run 5 cleared fall-in finish at 8:55
	tan/grey limestone with shale seams lg-vuggy filled w/ green clay; fossiliferous; sh-gr weathered		3"			
			5½"			
47	lt grey Limestone massive, fossiliferous. coral stylolitic		18"			start 6 @ 9:00
			10"			sh. parting

cont: DL-14

Drilling Log, continued

Boring No. MW-105

Project Name Rose Chem

Page 4 of 4

Project No. 88-025-4

Date 1/20/89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
				12½'			
19				3"	49	Box 3	shale parting
							finish run 6 @ 9:45
50	Total depth 50'				50		Completed coring MW-105. 10:20a
						1/20	Cement-bentonite grouted boring
						1/26	Reamed boring to 50' & installed 5' of 2" .010 pvc slotted screen to 50'. Gravel packed to 42.5', Bentonite pellets to 40.5'.
						1/28	Cement bentonite grout to surface.
							Completed 1/26/89.

Drilling Log

Doc. No. DL-16

Project Name: ROSE CHEM						Boring No.: MW-106	
Project No.: 88-025-4						Page: 1 of 4	
Ground Elevation: 831.2'	Location:					Total Footage: 49.7'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
AUGER/NX	6" to 4"	15'	34.7'	7	4	SEE REMARKS	
Drilling Co.: LAYNE Western Co.				Driller (s): RANDY CRAWEL			
Drilling Rig.: MOBILE B-61				Type of Penetration Test: STANDARD			
Date: 1-6-89	To: 1-27-89			Field Observer (s): PAUL CLARK / GREGN			

Depth	Description	Class.	Blow Count	Recov.	Sample or Box No.	Remarks
1	~~BRK~~ GRAVEL (FILL)		11/9/9/11	3/24	SS-1	START 1-6-89 3[04]P NO VOCs taken BORE HEAD - 0 ppm
2						3[07]
	DARK GRAY SILTY CLAY; MOIST;					3[12]
3	SOME GRAVEL		9/9/11/12	10/24	SS-2	NO VOA & SEMI TAKEN.
4						3[14]
	NO RECOVERY		15/5/5/3	NO REC.	SS-3	AUGER @ 3[18]P 3[23] 2" SPOON ~~SPOON TRIED~~ (REFUSED @ 6") UNABLE TO PUSH TUBE.
6						TRIED OUT OF HOLE WITH AUGER
	BROWN-GRAY MOTTLED SILTY CLAY;		4/6/7/10	15/24	SS-4	BORE HOLE: 0 ppm
7	STIFF; MOIST; TRACE GRAVEL					3[35]
	TOOK REP. VOC (SS10)					BORE HEAD: 0 ppm
8						3[56]
	SHELBY TUBE			12/13	ST-1	SHELBY TUBE TAKE
9						
	GRAY BROWN MOTTLED CLAY IN TUBE BOTTOM					3[58]
10	BROWN-GRAY MOTTED CLAY; DRY; STIFF		4/8/11/20	15/24	SS-5	
	GRADING TO BROWN IRON STAINED					4[02]
11	SHALELY CLAY. TOOK REP & SV REP (SS-11)					
						4[08]-
12	AS ABOVE GRADES TO		8/19/32/14	18/24	SS-6	4[15]P
	BITUMINOUS MATERIAL IN BOTTOM OF SPOON					
13	DRY IN BOTTOM OF RUN					
						STOP 4[35] 1-6-89
14	BITUMINOUS MATERIAL IN TOP; GRAY SHALE IN BOTTOM OF RUN		50 @ 5"	5/5	SS-7	START 1-7-89 8[32]A

SPOON CAME OUT WET

cont: DL-16

Drilling Log, continued

Boring No. MW-106
Project Name ROSE CHEM
Page 2 of 4
Project No. 88-025-4
Date 1-7-89¢

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	1/20/89 Remarks
15						AUGER @ 1-7-89 BEA
	LS - BOTTOM OF AUGERED HOLE					STOPPED AUG. 3:40A
16	lt. gry LS, fossiliferous-breach. Massive iron staining		11½" 1½"		Box 1 Ran 4½' Recover 4.2'	INSTALLED CASING & GROUTED IN PLACE. Started coring run #1 at 1:05p - 1/20/89
17	gry-grn sh. with LS inclusions, weathered, laminar, a few fossils		5½ 8½			
18	dk. gry Carboniferous Sh, weathered, Weak, lam.		2" 2" ½" 1"			
19	gry. Sh., weathered, lenticular, LS inclusions		2½" 7½" 2½" 3"			finish run #1 @ 1:40
20	gry grading into dk grey Shale, weathered, carboniferous, laminar		17½" 1'½" 1½" 9" 1" ½" 8" 1½" 3'6" 10" 4" 2½" 1" 3" 12" 16"		Box 1 Recovered 10.3'	start run #2 @ 1:50
21						21.5' - 8" hard, less weathered shale
22						
23						
24						
25						
26						fossiliferous 23'-28'
27						
28	lt. gry mottled Limestone, strong fossiliferous		10"		Box 2 Ran 10'	
29	Dk grey shale, weathered, Weak lenticular bedding		5" 8½" 4" ½" 1½" 1½" 1"			finish run 2 @ 3:00A
30						start run 3 @ 3:10p
31	LS		5"			

cont: DL-16

Drilling Log, continued

Boring No. MW-106

Project Name Rose Chem

Page 3 of 4

Project No. 88-025-4

Date 1/20/89 & 1/23/89

Depth	Description	Log or Class	N Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
32	lt. gry LS, stlong, fossiliferous, shaley partings.		4" 14" 4" 10"		Box 2 Recovered 9.6'	
34	Sh, carboniferous, dk grey, weathered		1" 3½"			
35	dk. grey Sh, weathered, lenticular bedding, LS inclusions, platey		4" 7½" 3" 14" 5" 4'			
37			4" 18" 2½" 4" 3½" 1½" 4" 5" 8"		Box 3 Ran 10'	Large LS inclusion @ 37' Red mottling 37.3' to 40' finished run #3 @ 1:30p started run #4 @ 8:50a 1/23/89
40						
41						Red mottling 40' to 41.2'
42						
43	Lt grey LS, Vuggy, vugs filled w/ light grn. clay, weathered, fractures - filled with cly. fossiliferous		2½" 1" 6" 6"		Box 3 Recovered 10'	vertical filled fractures 43.3 to 44.0
44	grn. shly LS hash, fossiliferous		7" 3"			
45	lt. gry LS, hard, dense, stylolitic, fossiliferous - coral,		8" 16" 10" 2" 4"		Box 4 Ran 9'9"	
46						
47						
48						

cont. DL-16

Drilling Log, continued

Boring No. MW-106

Project Name Rose Chem

Page 4 of 4

Project No. 88-025-4

Date 1/23/89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
49	carboniferous shly Ls Lt gry Ls with blk mottling, disturbed beds? Total 49.7'		16" 2" 8½"		49 Box 4 50 51	finish run 4 @ 11:15a Bentonite cement/grout to surface 1/23 Reamed boring and installed 5.0' of 0.010" slotted screen to 27.0'. Gravel packed to 20.0'. Bentonite pellets to 18.0' 1/28 Cement bentonite grout to surface. Completed 1/27/89

Drilling Log

Doc. No. DL-17

Project Name: ROSECHEM						Boring No.: MW-107	
Project No.: 88-025-4						Page: 1 of 4	
Ground Elevation: 831.4'	Location:					Total Footage: 50.0'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
HSA & NX-core	6" to 4"	12.5'	37.5'	6	4	SEE REMARKS	
Drilling Co.: Layne-Western Co, Inc						Driller (s): Randy Crowel & Rob Slayden	
Drilling Rig.: Mobile B-61						Type of Penetration Test: Standard	
Date: 1/5/89	To: 1-26-89					Field Observer (s): Paul Clark / GREG NICHOLS	

Depth	Description	Class.	Blow Count	Recov.	Sample or Box No.	Remarks
1	SILTY CLAY TO 4" GRAVEL & FILL MATERIAL		14/12/5/6	5/24	SS-1	Start @ 3:35p SAMPLE: 0 ppm
2						
3			3/4/6/7	0/24	SS-2	343 p DRILLER ADVANCED TO 4' to improve soil cont. by split spoon BORE HOLE: 0 ppm
4	DARK BROWN CLAY; SILTY IN PART					353 p
5			3/3/4/5	12/24	SS-3	SAMPLE: 0 ppm
6						352 p
7	SHELBY TUBE SAMPLE			24/24	ST-1	To SHELBY PUSHED 359 p Density 2.75 gm/cc
8	Bottom: Dark Brown Clay w/ organics					BORE HOLE: 0 ppm
9	GRAY-BROWN SILTY CLAY; MOIST; MED-HIGHLY PLASTIC; TRACE GRAVEL		6/6/10/8	24/24	SS-4	405 p SAMPLE: 0 ppm BORE HOLE: 0 ppm AUGER TO 10' @ 408 p STOP 1-5-89 @ 4 PM
10						
11	GRAY-BROWN (SILTY) CLAY; WET; STIFF; HIGHLY PLASTIC; GRAVELLY IN PART		7/9/10/16	16/24	SS-5	START 1-6-89 8:50 A AUGER FULL OF WATER SPOON EXTRACTED WET SAMPLE: 4.9 ppm
12	BLACK UNKNOWN Material (Bituminous) GRAY CLAY ALSO BITUMINOUS MATERIAL TO ABOVE IN BOTTOM Weathered LS.		60@5"	5/5	SS-6 NJ TO 50 SOME SHELL	SAMPLE SS6: 1.8 ppm AUGER @ 8:50 A SPOON REFUSAL / 0 ppm AUGER @ 9:00 WET (GRINDING) AUGER REFUSAL @ 12'
13				N		
14	Limestone, gray, strong, fresh to slightly weathered, thin hairline fractures:		15" 8"	F	1 2	CASING PLACED @ 10.5' A 9:45 A

cont DL-17

Drilling Log, continued

Project Name	ROSECHEM
Project No.	83-025-4
Boring No.	MW-107
Page	2 of 4
Date	1/14/89

Depth	Description	Log or Class	N Blow Count	Core Recov. & Loss	Length Core	Box or Sample No.	Remarks
15	Limestone, gray, fresh to slightly weathered, strong to very strong, thin horizontal fractures		17"				Began Run #1 8:55a
16	Becoming shaley		2" 2" 1"			Box #1 Run 7.0'	
17	Shale green-gray, portions banded by dark gray shale, weak, platy to fissile, clayey seams present, moderately weathered		11" 3" 2"				Run 1 45min.
18	Limestone gravel seam @ 18.0' (½" thick),		2" 2" 4" 7" 1" 5"			Run #1 Rec. 7.0'	End Run 1 @ 7:40a
20			10"				Began Run 2 @ 9:50a
21	As above		1" 7" 15"				
22	Iron staining		18" 1"				* Formation took a pit of water between 22.0' to 25.0'
25	Shale, green-gray, moderately weathered, weak to very weak					Box #2 Rec 9.7'	Run 2 70min
27			26"				
28	Limestone, gray, strong, fresh to slightly weathered		9"			Run #3 Run 10.0'	
29	Shale, green-gray, fissile, moderately weathered						
30	Limestone, gray, strong, slightly weathered						End Run 2 @ 11:00a
	Becoming shaley from fissile		7" 1" 1"			Run 3	Began Run 3 @ 11:...

cont: DE-17

Drilling Log, continued

Boring No. MW-107

Project Name ROSECHEM

Page 3 of 4

Project No. 88-025-4

Date 1/14/89

Depth	Description	Log or Class	Length Core Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
31	Shaley limestone, green gray, slightly to moderately weathered, strong to weak in shaley portion, fossiliferous, thin shale filled fractures.		5" 4" 1" 2"			
32	Limestone, gray, very strong, fresh to slighly weathered,		17"		Box #3 Rec 9.9'	
33			7" 14			Run 3 70min
34	Shale, green-gray to dark-gray, weak to very weak, moderate to slightly weathered, platey to fissile, areas of red to marroon coloring.		4" 7"			
35						
36	Limey gravel seam @ 36.9' (½ thick), clayey		23" 4"			
37			2" 1"		Run #3 Run 10.0'	
38			4" 9" 3"			
39	Becoming less fissile & more massive @ 38.9', weath, slightly weathered		5" 15"			End Run 3 12:20p
40						Began Run 4 2:00p
41	Contain ½" limey shale seams @ 41.9		21" 2"			
42	Limey shale, weak,		4" 2" 1" 1"		Box #3 Rec 9.8'	
43	limestone, gray, strong to very strong, slightly weathered to fresh, hair-line fractures, shaley in portions.		8" 2"			
44	Shale-filled hair fractures @ 44.6'		9" 12"			Run 4 60min
45			19"			
46	Thin hairline shale filled fractures @ 46.7		7"		Run #4 Run 10.0'	

cont: DL-17

Drilling Log, continued

Boring No. MW-107

Project Name ROSECHEM

Page 4 of 4

Project No. 88-025-4

Date 1/14/89

Depth	Description	Log or Class	N Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
48	Limestone, gray, fresh to slightly weathered, strong to very strong		14"			Run #4	
49	Becoming shaley limestone, abundant thin shale seam (dark gray) strong		15"				
50							End Run 4 3:00p Finished coring & flushed out bore w/ fresh water. 1/16 Conducted 3 packer test. Bentonite-cement grout to surface 1/25 Reamed and installed 5' of 0.010" slotted screen to 48.0' Gravel pack to 41.0' Bentonite pellets to 39.0' 1/28 Cement bentonite grout to surface. Completed 1/26/89
51	Total Depth 50.0'						
52							
53							
54							
55							
56							
57							
58							
59							
60							
61							
62							
63							

Drilling Log

Doc No. DL-18

Project Name						Boring No.
ROSE CHEM						MW-108
Project No.						Page 1 of 4
88-025-4						
Ground Elevation		Location				Total Footage
826.0'						47.5'
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water / Date Measured
AUGER/NX	6" to 4"	7.5'	40.0'	4	5	SEE REMARKS

Drilling Co.	LAYNE Western Co.	Driller (s)	RANDY CROUCH
Drilling Rig.	MOBILE B-61	Type of Penetration Test	STANDARD
Date	1-9-89 To 11/24/89	Field Observer (s)	PAUL CLARK & GREG NIEMAN

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
1	LIMONITIC CLAY & GRAVEL; STIFF; DAMP TO MOIST; GREEN & RED PAINT IN SAMPLE FROM UNKNOWN ORIGIN		7/7/12/13	12/24		SS-1	START 1-9-89 3.0 ppm BORE HEAD: 0 ppm SAMPLE: 0 ppm
2							3.5 ppm
3	IRON STAINED WEATHERED SHALE		16/21/30/34	10/24		SS-2	3.0 ppm BORE HEAD: 0 ppm SAMPLE: 0 ppm
4							3.10 ppm
5	IRON STAINED WEATHERED SHALE		30/34/32/39	15/24		SS-3	3.15 ppm BORE HEAD: 0 ppm SAMPLE: 0.6 ppm
6	COAL (4" to 3"						3.20 ppm
	COAL LIMESTONE NO PCB SAMPLE TAKEN POWDER ON TOP OF SPOONS		25/35 @ 2"	18/8		SS-4	BORE HEAD: 0.3 ppm 3.25 ppm SAMPLE: — ppm
7	LS, H. gry, massive, very strong fossiliferous.			7" 12"			3.32 ppm AUGER @ 3.35 ppm to 5' INSTALLED CASING TO 7.5' & GROUTED IN PLACE @ 4.05 ppm
8							
9							Start core #1 @ 1:30 7.5'
10	mottled lt. gry & gry LS, fossiliferous, strong			12"			
11	Shale w/ calcareous fossil pieces, highly weathered			3" 10½"			
12	gry-grn sh, weathered, iron staining & concretions (sm), platey Dk gry Sh., weathered (highly in areas), carbonaceous, laminar, iron staining			2½" 2½" 9½"			
13				3" 5" 3"			
14							

Box 1 Recovered 10'

Run 10'

090230 Burns & McDonnell Form TS-GT-2-1

cont: DL-18

Drilling Log, continued

Boring No. MW-108
Project Name Rose Chem
Page 2 of 4
Project No. 88-025-4
Date 1/24/89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
15			8½"			highly weathered 14.7' to 16.1'
16			6"			
17			2"	Box 1		finish run #1 @ 2:27p
			5½"			start run #2 @ 2:40p
18			3½"			Red mottling 17.5' to 18.0'
			fragments			
19			3" fragments			
			4"			
20			3"			
			2"			
21	Lt gry LS, shly, mottled		½"			
	gry sh, highly weathered, iron staining, little to no bedding		1½"			
22			2½"			
			1"			
23			3½"			
			4"			
			2½"			
24	gry LS, fossiliferous, weathered		2"			
			3"			
			12½"			
25	lt. gry & gry mottled LS, hard, dense, fossiliferous		5"	Box 2 Recovered 9.9'		
			4½"			
26	gry LS, horizontal partings, massive hard, dense		2"			
			7"			
27			9"			
			4"			
28			13"			
			6"			
29			17"	Run 10'		
			2"			
30			8"			
			2½"			
			½"			
			1"			finish run #2 @ 4:00p
			3"			start run #3 @ 8:20a 1/24/89
	lt grn. Sh, weathered, carbonaceous					.5' blk sh. at 28'
	dk gry grading into gm-gry Shale, weathered, LS inclusions		14"			
			22"			
			2½"	Box 3 Run 8.5' Recovered 8.5'		
			7½"			

cont: DL-18

Drilling Log, continued

Project Name RoseChem	Boring No. MW-108
Project No. 88-025-4	Page 3 of 4
	Date 11/21/89

Depth	Description	Log or Class	N Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
31						
32	gry Sh, highly weathered, crumbly; LS inclusions	4" 4"			Box 3	finish run #3 @ 9:50a
33	gry sh, weathered, LS inclusions, carbonaceous in places, iron staining	2½" 2" 7" frag. 7" 1½" 8" frag.				
34						
35						
36	lt. gry LS, weathered with grn clay filling weathered areas, mottled appearance	3" frag. 3"				start run #4 @ 10:00
37	lt. gry LS, fossiliferous - coral Strong stylolitic	9" 4" 11" 1"			Box 3	.5' shale w/ calcareous wash at 37'
38		18" 10"				
39		4½" 4½"				
40		21"			Recovered 9.5'	
41						
42	Lt gry LS, Strong, fossiliferous with blk sh fossiliferous; bioturbated, mottled	21"				
43						
44	Blk & Dk gry Sh, interbedded, laminar, weathered, fossils present.	7"			Box 4 Run 10'	green shale ½" at 44'
45	dk. gry sh., weathered, lenticular bedding, sm. sandy beds present	11" 3" 5"				
46	shly dk. gry SS with blk beds, fine grained	2⅓" 3"			Run 1.5' Recovered 2'	finish run 4 @ 11:00a start run 5 @ 11:10a
47		3" 5" 6" 2½"				finish run 5 @ 11:15a Cement bentonite grout from finish at 12:00
48	Total Depth 47.5'	1½"				

cont. DL-18

Drilling Log, continued

	Boring No. MW-108
Project Name ROSECHEM	Page 4 of 4
Project No. 88-025-4	Date 1/27/89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
49							Reamed and installed 5' of .010 slotted screen to 47.5' Gravel pack to 40.5 Bentonite pellets to 38.5 Cement bentonite grout to surface. Completed 1/28/89
50							
51							
52							
53							
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59							
60							
61							
62							
63							
64							

Drilling Log

Doc. No.: DL-19

Project Name: ROSE CHEM						Boring No.: MW-109	
Project No.: 88-025-4						Page: 1 of 4	
Ground Elevation: 835.7'	Location:					Total Footage: 50.0'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
AUGER/NX	6" to 4"	13'	37'	7	3	SEE REMARKS	

Drilling Co.: LAING Western Co. — Driller (s): RANDY CROWLEY

Drilling Rig: MOBILE B-61 — Type of Penetration Test: STANDARD

Date: 1-9-89 To 1-30-89 — Field Observer (s): PAUL CLARK & GREG VIEHMAN

Depth	Description	Class.	Blow Count	Recov.	Sample or Box No.	Remarks
1	GRAVEL & FILL MATERIAL		4/8/6/9	7/24	SS-1	START 1-9-89 10:25 A BORE HEAD: 0 ppm SAMPLE: 0 ppm
2	BROWN-GRAY SILTY CLAY; GRAVELLY; MOIST; MED-HIGH PLASTIC; STIFF IN BOTTOM		4/7/9/11	10/24	SS-2	10:50 A BORE HEAD: 0 ppm SAMPLE: 0 ppm
3						
4	BROWN-GRAY SILTY CLAY AS ABOVE GRADES TO					10:52 A 10:55 A
5	DARK GRAY SILTY CLAY; MOIST; MED TO HIGH PLASTIC.		13/15/17/66	24/24	SS-3	BORE HEAD: 0 ppm SAMPLE 0.4 ppm
6						10:21 A 10:26 A
7	DARK GRAY SILTY CLAY; MOIST; MED TO HIGH PLASTIC		10/11/12/16	18/24	SS-4	BORE HEAD: 0 ppm SAMPLE: 0 ppm
8	GRAY-BROWN SILTY CLAY; MOIST; MED TO HIGH PLASTIC; GRAVEL (TRACE); ORGANIC					10:32 A 10:38 A
9	GRAY-BROWN SILTY CLAY AS ABOVE GRADES TO BROWN WITH GRAY MOTTLED CLAY STIFF; IRON STAINED		12/9/15/18	22/24	SS-5	BORE HEAD: 0 ppm SAMPLE: 0 ppm
10	HIGHLY WEATHERED IRON STAINED SHALE					AUGER @ 10:53 A TO 10
11	WEATHERED CLAYEY SHALE; IRON STAINED WITH GRAY CLAY SEAMS		6/15/27/40	23/24	SS-6	10:58 A 11:02 A BORE HEAD: 0 ppm SAMPLING: 0 ppm
12	AS ABOVE; NO GRAY CLAY SEAM		27/50/3"	15/15	SS-7	11:08 A BORE HEAD: 0 ppm SAMPLING: 0.8 ppm
13						11:14 A
14	WEATHERED SHALE					AUGER @ 11:19 A TO 15' 11:24 A

cont. DL-19

Drilling Log, continued

Project Name	Rose Chem
Project No.	88-025-4
Boring No.	MW-109
Page	2 of 4
Date	1-9-89

Depth	Description	Log of Chan	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
15	GRAY SHALE (FRESH)		27/100 5"		SS-8	BOREHEAD: 0 ppm SAMPLE: 0.6 ppm 1128A
16						AUGER TO 18' - PLACED CASING & GROUTED - 12:30p
17						1/29/89 Start @ 1:45
18		N	19			
19	Dk gry Sh, laminar, weathered, carboniferous iron staining, plant fossils	3" 5" 4" 12"				Start run #1 @ 2:40p
20						
21	Dk gry & blk. Shale interbedded, laminar, weathered, carboniferous.	2" 7" 3" 1" 8" 1"			Box 1	Recovered 9.5'
22		3" 1" 1" 3"				
23	Coal					
24	Dk gry Sh. carboniferous, weathered.	3"				Run #1
25	Gry-grn Sh, highly weathered, Ls inclusions, carboniferous	2" 3" 5" 5" 2" 17" 6" 7" 4"				Run 10'
26						
27						
28		3" 2"				End run #1 @ 3:25p
29		frag 2" 1" 3" 4"			Box 2	Start run #2 @ 3:30p
30		3" 1"				

cont: DL-19

Drilling Log, continued

Boring No. MW-109
Project Name Rose Chem
Page 3 of 4
Project No. 88-025-4
Date 11/24/89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
32			1½" 2" 1½" 1½" 2"			
	Lt gry LS, mottled with dk gry, fossiliferous		3" 5" 7"			
33	grn-gry sh, weathered, LS inclusions		4" 2½" 1'5"			
34	gry LS with dk. gry sh beds, fossiliferous		9" 6" 2'3"		Box 2 Run 2 Recovered 9.5' Ran 10'	
	gry LS, hard, dense, sh. partings, fossiliferous,		6" 4'3" 5"			
36			4" 4"			
37			5'5" 1'3"			
38			9" 12" 2"			End run 2 @ 4:30p
39	Dk gry Sh. weathered, laminar, lt gry thin beds present (5%)		1" 1'5"		Box 3 Run 3 Recovered 5.8' Ran 6'	Start coring run 3 @ 8:30a 11/25/89
40	grn-gry Sh, highly weathered, weak		1" 4½" 5"			
	Dk gry Sh. weathered, laminar bedding		4" 4"			
41	Gry sh, highly weathered, LS inclusions		3"			
42			11" 4"			
43			5" 4" 1'3"			
44			7"			Finish run 3 @ 9:30 rain delay
	Dk gry sh, weathered, horizontal bedding		9" 2"			start run 4 @ 12:00
45			frag 6'3"			
46			3" 2'8"			
	Sh-LS weathered		9"		Run 4 Recovered 6.1' Ran 6'	
47	Lt. gry LS, fossiliferous, stylitic, broken along horizontal (cores) stylolites, weathered w/ grn clay filling		8" 6"			shale .5' at 47.9'
48						

cont. DL-19

Drilling Log, continued

Boring No. MW-109

Project Name RoseChem

Page 4 of 4

Project No. 88-025-4

Date 1/25/89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
49			10"		49		
			2"				
			1"				
			1"				
			9"				
50			2½"		50		finish run #4 @ 1:00 p
	Total Depth = 50 ft.						bentonite cement grouted to surface
51							Leave MW-109 @ 2:45 p
							1/30/89
52							Set 5' 2" pvc screen at 41' to 36'.
							Placed sand to 34'
53							Placed bentonite pellets to 32' Bentonite Cement Grouted to surface
						13	
54							Completed 1/31/89
55							
56							
57							
58							
59							
60							
61							
62							
63							
64							

Drilling Log

Doc. No. LB-20

Project Name: ROSE CHEM						Boring No.: MW-110	
Project No.: 88-025-4						Page: 1 of 4	
Ground Elevation: 836.3'	Location:					Total Footage: 50.0'	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
AUGER/NX	6" / 3 1/16"	19.5'	30.5'	7	4	SEE REMARKS	
Drilling Co.: LAYNE Western Co.						Driller (s): RANDY CROWELL	
Drilling Rig: B-61 MOBILE						Type of Penetration Test: STANDARD	
Date: 1-5-89	To: 1-31-89					Field Observer (s): GREG NIEMAN / PAUL CLARK	

Depth	Description	Class.	Blow Count	(UNCORR.) Recov.	Sample or Box No.	Remarks
1	BROWN SILTY CLAY; MOIST; ORGANICS SAND & GRAVEL.		5/21/9/7	7/24	SS-1	START: 9 00 A BZ - 0 ppm - SAMPLE AUGER GRINDING ON GRAVEL.
2	DARK GRAY SILTY CLAY; MOIST; HIGHLY PLASTIC; TRACE GRAVEL; MOTTLED (BROWN)		9/14/15/15	8/24	SS-2	BOREHOLE HEADSPACE 9 12 0 ppm BZ - 1 ppm - SAMPLE
3						
4	GRAY-BROWN MOTTLED STIFF CLAY; MOIST; IRON STAINED; TRACE SAND AND GRAVEL		9/14/15/14	18/24	SS-3	AUGER SPOILS 9 16 0 ppm (SPOILS GRAVEL) BZ - 2.0 ppm HEADSPACE
5						
6						BORE HOLE/AUGER 1 ppm
7	GRAY - BROWN MOTTLED STIFF CLAY; MOIST IRON STAINED; GRAVEL IN FIRST 2 INCHES.		12/14/14/15	22/24	SS-4	9 21 BOREHOLE HEADSPACE - 0 ppm 1 ppm - SAMPLE
8						AUGER FOR SHELBY 9 30 A
9	SHELBY SAMPLE				ST-1	9 55 A SHELBY TUBE TO PUSHED EASY 9 25 A
10	BOTTOM OF TUBE: BROWN-GRAY MOTTLED CLAY BROWN-GRAY MOTTLED STIFF CLAY; MOIST IN PART.					1.75 PSF 10 00 A 0 ppm - SAMPLE
11			3/9/14/28	19/24	SS-5	
12	GRAY-BROWN SHALEY CLAY - DRY @ BOTTOM					10 05 A
13	TAN BROWN TO ORANGE BROWN DRY SHALEY CLAY; GRAY IN PART AT TOP		20/36/50/5"	16/24	SS-6	2 ppm - SAMPLE AUGER SPOILS 1.5 ppm
14	WEATHERED SHALE. - - - — —					10 20 A

cont. LB-20

Drilling Log, continued

Boring No. MW-110

Project Name ROSECHEM

Page 2 of 4

Project No. 88-025-4

Date 1-5-89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
15			42/50 @2"	7/8		SS-7	0.7 ppm - Sample
16	GRAY FISSILE SHALE; DRY; SLIGHTLY WEATHERED IN PART						
	As ABOVE						
17							
18							
19	As ABOVE						STOPPED AUGER 10 40 A E
20	VERY SOFT, GRAY SHALE; Fissile in part; very weak		RQD 1.5" 12.0" 1.0" 1.0" 1.0" 2.0" 1.0" 1.0" 9.5" 10.0" 4.5" 1.0"	3.71 / 5.0'	Box 1		INSTALLED CASING TO 19.5' DEPTH & GROUTED IN PLACE 1 EP
21	BLACK SHALE; W-S; VERY FISSILE						START 1-10-89 34 P
	COAL; HARD; PYRITE INCLUSIONS & WATER MOVEMENTS						NO CORING AFTER REAMING OF HOLE
	GRAY LIMESTONE WITH MULTIPLE HEALED FRACTURES FILLED WITH BLACK PEAT MATERIAL						PSI = 250
22	MASSIVE GRAY LIMESTONE WITH STYLOLITES						
23	GRAY LIMESTONE INTERBEDDED WITH Glauconitic CLAY SEAMS.						
24							
	CLAYEY, PUNKY GRAY LIMESTONE				Run 1		END 4 P
25	GRAY GREEN FISSILE SHALE; VS; TRACE GRAVEL		1.5" 1.0" 1.0" 2.5" 3.0" 1.0" 1.0" 3.0" 3.0" 2.0" 2.0" 2.0" 2.0" 2.0" 4.0" 1.5" 1.0" 2.0" 3.0"	3" 2.0" 9.5" 3.0" 1.0" 1.0" 4.67' / 5.0'	Box 1		START RUN 2 1-11-89 8 57 A
26	RED BROWN CLAYEY SHALE; VS						250 psi
	GRAY GREEN FISSILLY SHALE; CLAYEY; VS						
27							CORE HIGHLY FRACTURED
	WHITISH GRAY LIMESTONE						
	GRAY GREEN TO MAROON GREEN CLAYEY SHALE; Weak TO MED Weak; CROSS BEDDED IN PART.						
28							
29					Run 2		
30							END RUN 2 9 05 A
	GRAY GREEN CLAYEY SHALE; SLMS; GRADES TO A MAROON/GREEN SHALE		4.0" 1.5" 1.0" 1.0"		Box 3		START RUN 3 9 27 A
31							

cont: LB-20

Drilling Log, continued

Project Name	Rose Chem
Project No.	88-025-4
Boring No.	MW-110
Page	3 of 4
Date	1-5-89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
32	MAROON-GREEN HIGHLY FISSILLY SHALE; WEAK (~~MS-SLTST~~); CLAYEY IN PART		2.0, 1.5, 2.0, 1.0, 1.0, 1.0, 1.5, 1.0, 2.5, 2.0, 2.5, 4.0, 4.0, 3.0, 3.0, 9.0, 9.0	8.5'/10	Box 3	
33	GRAY & GREEN SHALE; SOME FISSILITY; SILTY; MS					
34	GRAY LIMESTONE; FOSSILIFEROUS IN PART					
35	GRAY-GREEN SHALE; MASSIVE WITH FISSILLY SHALE SEAMS; VERY CLAYEY IN PART; W-MS		3.0, 2.0, 6.0, 7.0, 3.0, 3.0, 1.5, 3.0, 4.0, 1.5, 1.0, 1.0			
36						
37						
38						GOOD WATER CIR. THRU-OUT RUN
39	GRAY GREEN LIMEY SHALE INTERBEDDED WITH LIMESTONE LAYERS.				RUN 3	PRESSURE CAME @ 250 psi
40	WHITISH GRAY LIMESTONE		7.0', 2.0", 2.0', 35", 12.0", 2.0", 26.0", 3.0, 3.0', 10.0", 11.0", 7.0", 14.0", 17.0", 1.0	10.4'/10		END RUN 3 10 25A START RUN 4 11 15A
41						
42	DARK GRAY SHALE; MASSIVE					
43	LIGHT GRAY SHALE; MASSIVE; LIMESTONE SEAMS (0.5" to 1" thick); CLAYEY IN PART					
44						
45						
46						GOOD WATER CIR. PRESSURE: 250 psi
47						
50						

cont LB-20

Drilling Log, continued

Boring No. MW-110

Project Name ROSE CLEN.

Page 4 of 4

Project No. 88-025-4

Date 1-5-89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
49	Light gray shale, massive, limestone seams (0.5" to 1" thick), clayey in part.						Finish run 4 @ 12 25 1/1-1/13 Flushed bore, Ran 3 Packer Tests, Bentonite Cement to 19'
50						1/30	Reamed and installed 5' of 0.010" slotted screen to 25.0' Gravel packed to 18.0' Bentonite pellets to 16.0'
51						1/31	Cement bentonite grout to surface. Completed 1/31/89
52							
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64							

Drilling Log

Doc. No. LB-21

Project Name	Boring No.
ROSE CHEM	MW-111
Project No.	**Page** 1 of 4
88-025-4	
Ground Elevation 815.4'	**Location**	**Total Footage** 48.0'

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
HSA / NX-core	6" to 4"	20.0'	28.0'	8	3	SEE REMARKS	

Drilling Co. Layne-Western Co.	**Driller (s)** Randy Crowe
Drilling Rig. Mobile B-61	**Type of Penetration Test** Standard
Date 1/10/89 **To** 2/1/89	**Field Observer (s)** Paul Starzyk & Greg Nichols

Depth	Description	Class.	Blow Count	Recov.	Sample or Box No.	Remarks
1	MED BROWN SILTY CLAY; MOIST; GRAVEL; ORGANICS; GLASS		1/3/10/5	10/24	SS-1	MONITOR: TIP II Start @ 8:45a 1-10-88 BORE HEAD: 0 ppm SAMPLE: —
2	AS ABOVE; MORE GRAVEL		4/5/11/14	8/24	SS-2	8 56 A 8 58 A BORE HEAD: 0 ppm SAMPLE: 0.4 ppm
3						
4	BROWN WITH GRAY MOTTLED CLAY; MOIST; IRON STAINED; VERY HARD		13/17/16/21	8/24	SS-3 SS-80 VOC DUP	9 00 A 9 02 A BORE HEAD: 0 ppm SAMPLE: — ppm
5						
6	GRAY MOTTLED BROWN CLAY; SILTY; MOIST; TRACE GRAVEL; STIFF; PLASTIC		66/19/16/18	17/24	SS-4 SS-90 FOR DUP	9 07 A 9 13 A BORE HEAD: 0 ppm SAMPLE: 0.5 ppm
7						
8	GRAY MOTTLED BROWN CLAY; SHALELY LIMONITIC; STIFF; MED. PLASTIC		9/8/3/7	24/24	SS-5 EPA DUP SS-10	9 17 A 9 20 A BORE HEAD 0.5 ppm SAMPLE: 0.8 ppm
9						
10	GRAY MOTTLED BROWN CLAY GRADING TO A DARK BROWN SILTY (SHALELY) CLAY		6/7/5/6	24/24	SS-6 DUP SS-11	9 30 A 9 34 A BORE HEAD: 0.8 ppm SAMPLE: 0.4 ppm
11						
12	AS ABOVE		6/7/5/7	24/24	SS-7	9 37 A 9 35 A BORE HEAD: 0 ppm SAMPLE
13						
14	HIGHLY WEATHERED UPPER SHALE BOTTOM 3"					9 36 A

cont. LB-21

Drilling Log, continued

Boring No. MW 111

Project Name ROSE CREEK

Page 2 of 4

Project No. 88-025-4

Date 1-10-89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
15	HIGHLY WEATHERED GRAY BROWN SHALE, LIMESTONE AT BOTTOM.		14/45-1"		SS-8	1-10-89 9:47A STEAM BREAKOUT UP INSIDE WATER AUGER TO 15' SAMPLE SS-8 : 0.3 ppm
	LIMESTONE (AUGER GRINDING)					
16	- AUGER STOPPED GRINDING AT 15.5'					
	GRAY SHALE					
17						BORE HEAD: 0 ppm
18						INSTALLED CASING AND GROUTED IN PLACE 10:15A
	GRAY SHALE					
19						
20	Gray shale, medium, strong, massive, weathered texture			8" 9½" 5" 9" 11" 5" 5" 2" 9"		Began 1st run 1:01p
21						
22						BOX #1 RUN #1
23						
24	Light gray limestone, very fine grain, slightly chloritic, vugular, trace of stylolites, some bedding planes visable, slightly weathered.			3½" 3" 2½" 3"		
25	Light gray limestone, massive, [illegible], very strong, [illegible], traces of coral fossils.					REC 9'3" CORED 10'0"
26						
27						
28						
29						
30				4½" 5½"		Began 2nd run 2:14p
31						

cont: LB-21

Drilling Log, continued

Boring No. MW-111

Project Name Rose Chem

Page 3 of 4

Project No. 88-025-4

Date 1/31/89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
31	Light gray limestone, very fine grain, massive, strong, traces of coral fossils, visable fractures vertically and horizontally.			7"		
32				15½"	Box 2 Run 2	
33	Light gray limestone with interbedded thin layers of black shale, very disturbed, turbidized.			4"		
34	Gray shale, weathered, massive, weak to moderately strong.			15"		
35	Sandstone, gray, dirty, silty, traces of detrital muscovite, fine grain.			7"		
36				8"	Cored 10'8" Rec'd 8'0"	
37	Interbedded shale and sandstone lamina, visable bedding planes, dirty, Increasing in shale content with depth.			2½"		
38				3"		
39				5½"		
40				3"		Finished 2nd RUN 2:50p Began 3rd RUN 3:05p.
41				3"		
42				5½"	Box 3 Run 3	
43				2"		
44	Dark gray shale, weak, massive, slightly carbonaceous.			4"		
45				5"		
46	Light gray limestone, fine grain, massive, stylolites, fossiliferous, strong			10½"	Cored 8'0" Rec'd 9'6" (2'0" from Run 2)	
47				3½"		Finish 3rd Run 4:05p Bentonite cement grouted to surface
48				4"		
				4½"		
				2"		
				2"		
				1"		
				4"		
				8"		
				11"		
				7"		
				5"		

cont: LB-21

Drilling Log, continued

	Boring No. MW-111
Project Name ROSECHEM	Page 4 of 4
Project No. 88-025-4	Date 2/1/89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
49						2/1	Reamed and installed 5' of 0.010" slotted screen to 38.0' Gravel pack to 30.0' Bentonite pellets to 28.0' Cement bentonite grout to surface. Completed 2/1/89.
50							
51							
52							
53							
54							
55							
56							
57							
58							
59							
60							
61							
62							
63							
64							

Drilling Log

Doc. No. LB-22

Project Name: ROSECHEM						Boring No.: MW-204	
Project No.: 88-025-4						Page: 1 of 1	
Ground Elevation: 823.8'	Location:					Total Footage: 5' 0"	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
HOLLOW STEM AUGER	6"	4' 0"	1' 0"	0	N/A	SEE REMARKS	

Drilling Co.: LAYNE WESTERN — Driller (s): TOM BUTLER, RUSTY BOWLES

Drilling Rig.: CME-55 — Type of Penetration Test:

Date: 1/25/89 — To: 1/25/89 — Field Observer (s): D. BALLARD

Depth	Description	Class.	Blow Count	Recov.	Sample or Box No.	Remarks
1	Brown-orange mottled clay, moist, medium plasticity, iron staining, trace of gravel in 0'-1' interval.					START 12:30p 0 ppm/TIP/Cuttings
2	Dark brown clay, moist, medium plasticity, trace organic debris					
3						
4	Light gray limestone, fine grain, massive, strong.					207 ppm/TIP/Cuttings Solvent odor at top of rock
5	Total Depth 5'0"					Finished well installation at 1:15p. Dry at completion Set 2' of 0.010" slotted screen at 5' Gravel pack to 2' Bentonite pellets 1.5' Cement bentonite grout to surface.
6						
7						
8						
9						
10						
11						
12						
13						

Drilling Log

Doc. No. DL-23

Project Name						Boring No.
ROSECHEM						MW-205
Project No.						Page 1 of 2
88-025-4						
Ground Elevation		Location				Total Footage
834.3'						15' 0"

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
HOLLOW STEM AUGER	6"	13.0'	2.0'	0	N/A	SEE REMARKS	

Drilling Co.	LAYNE WESTERN	Driller (s)	TOM BUTLER, RUSTY BOWLES
Drilling Rig.	CME-55	Type of Penetration Test	
Date	1/25/89 To 1/25/89	Field Observer (s)	D. BALLARD

Depth	Description	Class.	Blow Count	Recov.	Sample or Box No.	Remarks
0	Brown clay, moist, medium plasticity					START 8:30a.
3	Brown-orange mottled, moist, medium plasticity, iron staining.					
8	Light brown clay, dry to damp, low plasticity					
13	Gray shale, massive					

cont: DL-23

Drilling Log, continued

Project Name	ROSECHEM
Project No.	88-025-4
Boring No.	MW-205
Page	2 of 2
Date	1/25/09

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
15	Gray Shale					
	Total Depth 15'0"					Finished well installation at 9:45a. in the rain. Hole dry at completion. Set 5' of 0.010" slotted screen at 14.5' Gravel pack to 7.5' Bentonite pellets to 5.5' Cement bentonite grout to surface. Complete 1/25/09

Drilling Log

Doc. No. DL-24

Project Name		Boring No.
ROSECHEM		MW-206
Project No.		**Page** 1 of 2
88-025-4		
Ground Elevation	**Location**	**Total Footage**
831.0'		14' 0"

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
HOLLOW STEM AUGER	6"	12' 6"	1' 6"	0	N/A	SEE REMARKS	

Drilling Co.	LAYNE WESTERN	Driller (s)	TOM BUTLER, RUSTY BOWLES
Drilling Rig.	CME-55	Type of Penetration Test	
Date	1/24/89 To 1/24/89	Field Observer (s)	D. BALLARD

Depth	Description	Class.	Blow Count	Recov.	Sample or Box No.	Remarks
0	Gravel and fill material					START 8:30 a.
2	Brown clay, moist, medium, medium plasticity, trace of gravel					
3	Dark Brown, damp, low plasticity, medium, trace of gravel					
5						3 ppm/TIP/Cuttings Hit gravel layer at 5'0"
8	Orange-Brown mottled, moist, medium plasticity, medium, iron staining					
9	Brown-gray mottled clay, moist, medium plasticity, medium					
10						32 ppm/TIP/Cuttings
11	Brown weathered shale and interbedded orange-brown mottled clay					
12	Black carbonaceous material					270 ppm/TIP/Borehole 9 ppm Breathing Space
13	Gray limestone, massive, Strong					Water in hole at T.D. 14'0"
						Finish 10:00 a.

cont: DL-24

Drilling Log, continued

	Boring No. MW-206
Project Name ROSECHEM	Page 2 of 2
Project No. 88-025-4	Date 1/24/89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
15							Installed 5' of 0.010" slotted screen to 13.5' gravel pack to 6.5' Bentonite pellets to 4.5' cement bentonite grout to surface.
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

Drilling Log

Doc. No. DL-25

Project Name						Boring No.	
ROSECHEM						MW-207	
Project No.						Page 1 of 2	
88-025-4							
Ground Elevation	831.3'	Location				Total Footage	14' 0"
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
HOLLOW STEM AUGER	6"	1' 6"	14' 0"	0	N/A	SEE REMARKS	
Drilling Co.	LAYNE WESTERN			Driller (s)	TOM BUTLER, RUSTY BOWLES		
Drilling Rig.	CME-55			Type of Penetration Test			
Date	1/23/89	To	1/23/89	Field Observer (s)	D. BALLARD		

Depth	Description	Class.	Blow Count	Recov.	Sample or Box No.	Remarks
0	Brown clay, damp, medium to stiff, medium plasticity; trace of gravel					START 3:00p
1						TIP/.5ppm/Cuttings
2						
3	Dark brown clay, moist, soft to medium, highly plastic, trace of gravel					
4						
5						10ppm/TIP/Cuttings
6						
7						Gravel ledge at 7'0" - 7'3"
8						
9	Gray brown clay, medium to stiff, damp to moist, medium plasticity					
10						TIP/15ppm/Cuttings
11	Orange-brown mottled clay, moist, stiff, medium plasticity, iron staining.					
12	Black carbonaceous material					
13	Light gray limestone, massive, strong, slightly weathered at top.					Changed bits @ 13'6"
						Finished 4:13p

cont: DL-25

Drilling Log, continued

	Boring No. MW-207
Project Name ROSECHEM	Page 2 of 2
Project No. 88-025-4	Date 1/23/89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
15							Installed 5' of 0.01" slotted screen to 13.5' Gravel pack to 6.5' Bentonite pellets to 4.0' Cement bentonite grout to surface. Completed 1/23/89
16							
17							
18							
19							
20							
21							
22							
23							
24							
25							
26							
27							
28							
29							
30							

Drilling Log

Doc. No. DL-26

Project Name: ROSECHEM						Boring No.: MW-208	
Project No.: 88-025-4						Page: 1 of 1	
Ground Elevation: 825.3'	Location:					Total Footage: 8' 0"	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
HOLLOW STEM AUGER	6"	6'0"	2'0"	0	N/A	SEE REMARKS	

Drilling Co.: LAYNE WESTERN — Driller (s): TOM BUTLER, ROSTY BOWLES

Drilling Rig.: CME-55 — Type of Penetration Test:

Date: 1/23/89 — To: 1/23/89 — Field Observer (s): D. BALLARD

Depth	Description	Class.	Blow Count	Recov.	Sample or Box No.	Remarks
1	Brown clay, dry to damp, low plasticity, iron staining					START 1:50 p TIP/0ppm/Cuttings
2	Weathered shale and interbedded brown clay					
3						
4						
5						
6	Black Gray limestone, , massive, slightly weathered					
7	Gray limestone, very strong, massive					TIP/0ppm/Cuttings Finished drilling at 2:15 p.
8	Total Depth = 8'0"					Dry at completion Finished installation at 2:55 p.
9						Installed 5' of 0.010" slotted screen to 7.5 Gravel pack to 2.0' Bentonite pellets to 1.5' Cement bentonite grout to surface.
10						
11						
12						
13						

Drilling Log

Doc. No. DL-27

Project Name						Boring No.
ROSECHEM						MW-209
Project No.						Page 1 of 2
BB-025-4						
Ground Elevation 835.9'	Location					Total Footage 14' 6"

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
HOLLOW STEM AUGER	6"	13' 6"	1' 0"	0	N/A	SEE REMARKS	

Drilling Co.	LAYNE WESTERN	Driller (s)	TOM BUTLER, RANDY BOWLES
Drilling Rig.	CME-55	Type of Penetration Test	
Date 1/23/89	To 1/23/89	Field Observer (s)	DEBBIE BALLARD

Depth	Description	Class.	Blow Count	Recov.	Sample or Box No.	Remarks
0–3	Brown clay, moist, medium, medium plasticity, organic debris.					START 8:40a. TIP = .2 ppm borehole
3–10	Gray-Green mottled clay, medium, damp to moist, medium plasticity.					Hit gravel at 4'on 2.3 ppm/TIP borehole cuttings
10–13	Brown-orange mottled clay, dry to damp, low plasticity, iron staining.					TIP = 39 ppm in Borehole.
13	Orange Brown mottled clay, dry, stiff, weathered shale at 13'6"					

cont: DL-27

Drilling Log, continued

	Boring No. MW-209
Project Name ROSECHEM	Page 2 of 2
Project No. 88-025-4	Date 1/23/89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss		Box or Sample No.	Remarks
	Orange-Brown weathered shale						Finish drilling at 9:10a
15	Total Depth = 14'6"				15		ppm TIP - Borehole
16					16		TIP = 189 ppm in borehole at completion. Put on respirators. Breathing space was 57 ppm.
17					17		Dry at completion.
18					18		Finished well installation at 10:30a.
19					19		Installed 5' of 0.010" slotted screen to 14.5'
20					20		Gravel pack to 7.5'
21					21		Bentonite pellets to 5.5'
22					22		Cement bentonite grout to surface.
23					23		
24					24		
25					25		
26					26		
27					27		
28					28		
29					29		
30					30		

Drilling Log

Doc No DL-28

Project Name		Boring No.
ROSECHEM		MW-210
Project No.		**Page** 1 of 2
88-025-4		
Ground Elevation	**Location**	**Total Footage**
836.0'		15' 0"

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
HOLLOW STEM AUGER	6"	13' 6"	1' 6"	0	N/A	SEE REMARKS	

Drilling Co. LAYNE WESTERN	**Driller (s)** TOM BUTLER, RUSTY BOWLES
Drilling Rig. CME-55	**Type of Penetration Test**
Date 1/23/89 **To** 1/23/89	**Field Observer (s)** D. BALLARD

Depth	Description	Class.	Blow Count	Recov.	Sample or Box No.	Remarks
	Concrete and gravel pad					START 11:00 a.
1	Dark brown clay, moist, medium, medium plasticity, organic debris.					2ppm/TIP/borehole
3	Gray green clay. damp, medium, medium plasticity					7ppm/TIP/Cuttings
7	Orange brown mottled clay, stiff, damp, medium plasticity, iron staining,					10 ppm/TIP/cuttings
12						47ppm/TIP/Cuttings
13	Orange brown mottled clay with interbedded weathered shale.					weathered shale at 13'6"

cont: DL-28

Drilling Log, continued

Boring No. MW-210

Project Name ROSECHEM

Page 2 of 2

Project No. 88-025-4

Date 1/23/89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
15	Gray shale, firm					
	Total Depth 15'0"					Finished Drilling at 11:45a. Dry at completion TIP/13ppm/Borehole Well installed and complete at 1:30p. Installed 5' of 0.010" slotted screen to 14.5' Gravel pack to 7.5' Bentonite pellets to 5.5' cement bentonite grout to surface.
16						
17						
18						
19						
20						
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

Drilling Log

Doc. No. DL-29

Project Name						Boring No.	
ROSECHEM						MW-211	
Project No.						Page 1 of 2	
88-025-4							
Ground Elevation		Location				Total Footage	
815.1'						16' 0"	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
HOLLOW STEM AUGER	6"	15'0"	1' 0"	0	N/A	SEE REMARKS	
Drilling Co.	LAYNE WESTERN				Driller (s)	TOM BUTLER, RUSTY BOWLES	
Drilling Rig.	CME-55				Type of Penetration Test		
Date	1/24/89	To	1/24/89		Field Observer (s)	D. BALLARD	

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
1	Dark brown clay, moist, medium to soft, highly plastic, trace of organic debris						START 3:16a. 0ppm/TIP/Cuttings
2							
3	Brown-orange clay, slightly silty, damp, medium, medium plasticity, iron staining, trace of gravel						
4							
5							
6							
7							
8	Brown silty clay, dry to damp, low plasticity, medium						
9							
10							
11							
12	Gray brown clay, damp, medium plasticity						
13							

Conti DL-29

Drilling Log, continued

Boring No. MW-211

Project Name ROSECHEM

Page 2 of 2

Project No. 88-025-4

Date 1/24/89

Depth	Description	Log or Class	Blow Count	Core Recov. & Loss	Box or Sample No.	Remarks
15	Gray brown clay, damp, medium plasticity					
15	Gray limestone, microcrystalline, dense, massive					Finish augers at 3:45p
16	Total Depth: 16' 0"					Finish well installation at 5:15p.
16						Dry at completion.
17						Installed 5' of 0.010" slotted screen to 16'
18						Gravel pack to 9'
19						Bentonite pellets to 7'
20						Cement bentonite grout to surface.
21						
22						
23						
24						
25						
26						
27						
28						
29						
30						

APPENDIX B - OBSERVED WATER LEVEL READINGS

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of _____

Project Name ROSECHEM	Project No. 88-025-4	Hole No. MW-101
Location	Elev. Ground Surface (G.S.) 817.9'	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 820.66	
Date Started Drilling Hole Time	Total Depth of Hole	Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer	Footage Slotted
Date Piezometer Installed Time		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev. (ft)	Remarks
2/16/89	8:12a	R. Slayden	8.56' from T.O.P	812.10	
2/21/89	3:35p	" "	8.64' from T.O.P.	812.02	Baled
3/2/89	9:44a	D. Ballard	15.30' from T.O.P.	805.36	
3/3/89	8:30a	D. Ballard	15.30' from T.O.P	805.36	Baled dry (10gal)
3/6/89	12:30p	G. Nieman	36.22' from T.O.P.	784.44	Bailed dry (5gal)
3/7/89	9:10a	G. Nieman	45.91' from T.O.P.	774.75	sampled
3/29/89	1:38p	M. Hildebrandt	10.23' from T.O.P.	810.43	
4/5/89	8:04p	G. Nieman	9.85' from T.O.P.	810.81	
4/10/89	8:30a	G. Nieman	9.64' from T.O.P.	810.02	Bailed dry (10 gals)
4/10/89	2:05p	G. Nieman	47.72' from T.O.P.	772.94	sampled
4/28/89	a	K. Smith	11.00' from T.O.P.	809.66	
5/5/89	12:34p	M. Hildebrandt	10.32' from T.O.P.	810.34	
5/12/89	15:30	J. Hollingsworth	10.13' from T.O.P.	810.53	
5/24/89	3:08p	M. Hildebrandt	6.87' from T.O.P.	813.79	
6/19/89	2:35p	M. Hildebrandt	10.00' from T.O.P.	810.66	Bailed dry
6/20/89	10:30a	M. Hildebrandt	46.65' from T.O.P.	774.01	Sampled

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name	Project No.	Hole No.
ROSECHEM	88-025-4	MW-101

Location	Elev. Ground Surface (G.S.) 817.9'
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 820.66
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6-29-89		J. HOLLINGSWORTH	16.23 from TOP	804.43	
7-14-89		J. HOLLINGSWORTH	11.25 from TOP	809.41	
7-20-89		J. HOLLINGSWORTH	11.6 from TOP	809.06	
7-27-89		J HOLLINGSWORTH	11.11 from T.O.P	809.55	
8-14-89		J. HOLLINGSWORTH	10.84 from T.O.P	809.82	
9-11-89		J. HOLLINGSWORTH	10.67 from T.O.P.	809.99	
10-2-89		J HOLLINGSWORTH	10.51 from T.O.P	810.15	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of _____

Project Name	ROSECHEM	Project No.	88-025-4	Hole No.	MW-102
Location				Elev. Ground Surface (G.S.)	829.6
N	E			Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.)	831.89
Date Started Drilling Hole	Time			Total Depth of Hole	Drilling Type
Date Completed Drilling Hole	Time				
Date Piezometer Installed	Time			Total Depth of Piezometer	Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/16/89	8:35a	R. Slayden	11.67' from T.O.P	820.22	
2/20/89	11:15a	R. Slayden	11.64' from T.O.P.	820.25	Bailed dry
2/24/89	8:30a	R. Slayden	13.39' from T.O.P.	818.50	Bailed dry (11gal.), sampled
3/2/89	8:44a	D. Ballard	13.04' from T.O.P.	818.85	
3/8/89	9:29a	G. Nieman	12.50' from T.O.P.	819.39	
3/29/89	2:03p	M. Hildebrandt	12.34' from T.O.P.	819.55	
4/5/89	8:47a	G. Nieman	12.34' from T.O.P.	819.55	Bailed dry (10gal.); sampled
4/28/89	a	K. Smith	12.73' from T.O.P.	819.16	
5/5/89	11:33a	M. Hildebrandt	12.66' from T.O.P.	819.23	
5/12/89	16:43	J. Hollingsworth	12.74' from T.O.P.	819.15	
5/24/89	2:47p	M. Hildebrandt	12.67' from T.O.P.	819.22	
6/15/89	8:50a	G. Nieman	12.90' from T.O.P.	818.99	Bailed dry (11 gals.) sampled.
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name	Project No	Hole No.
Rosechem	88-025-4	MW-102

Location	Elev. Ground Surface (G.S.) 829.6
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 831.89
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6-29-89		J. HOLLINGSWORTH	13.44 from T.O.P	818.45	
7-14-89		J. HOLLINGSWORTH	13.2 from T.O.P.	818.69	
7-20-89		J. HOLLINGSWORTH	13.22 from T.O.P.	818.67	
7-27-89		J. HOLLINGSWORTH	13.21 from T.O.P.	818.68	
8-14-89		J. HOLLINGSWORTH	13.21 from T.O.P.	818.68	
9-11-89		J. HOLLINGSWORTH	12.93 from T.O.P.	818.96	
10-2-89		J. HOLLINGSWORTH	12.66 from T.O.P.	819.23	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of _____

Project Name	Project No.	Hole No.
ROSECHEM	88-025-4	MW-103

Location	Elev. Ground Surface (G.S.) 812.3
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 814.53
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/16/89	8:45a	R. Slayden	7.17' from T.O.P	807.36	
2/21/89	1:50p	" "	6.60' from T.O.P.	807.93	Bailed 10 gallons.
3/1/89	11:10a	D. Ballard	23.09' from T.O.P.	791.44	Bailed dry (8 gal)
3/2/89	10:00a	D. Ballard	46.77' from T.O.P.	767.76	sampled
3/8/89	9:40a	G. Nieman	28.98' from T.O.P.	785.55	
3/27/89	1:53p	M. Hildebrandt	9.85' from T.O.P.	804.68	
4/5/89	8:12a	G. Nieman	5.96' from T.O.P.	808.57	
4/11/89	7:30a	G. Nieman	9.45' from T.O.P.	805.08	Bailed 9 gals.
4/11/89	12:35p	G. Nieman	48.96' from T.O.P.	765.57	sampled
4/28/89	a	K. Smith	11.85' from T.O.P.	802.68	
5/5/89	11:52a	M. Hildebrandt	10.25' from T.O.P.	804.28	
5/12/89	16:00	J. Hollingsworth	9.89' from T.O.P.	804.64	
5/24/89	3:01p	M. Hildebrandt	9.59' from T.O.P.	804.94	
6/21/89	12:50p	M. Hildebrandt	9.70' from T.O.P.	804.83	Bailed dry
6/22/89	9:33a	M. Hildebrandt	46.87' from T.O.P.	767.66	Sampled
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name	Project No.	Hole No.
Rosechem	88-025-4	MW-103

Location	Elev. Ground Surface (G.S.) 812.3
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 814.53
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6-29-89		J. HOLLINGSWORTH	24.07 from T.O.P.	790.46	
7-14-89		J. HOLLINGSWORTH	11.81 from T.O.P.	802.72	
7-20-89		J. HOLLINGSWORTH	11.51 from T.O.P.	803.02	
7-27-89		J. HOLLINGSWORTH	10.81 from T.O.P.	803.72	
8-14-89		J. HOLLINGSWORTH	10.27 from T.O.P.	804.26	
9-11-89		J. HOLLINGSWORTH	13.10 from T.O.P.	801.43	
10-2-89		J. HOLLINGSWORTH	9.92 from T.O.P.	804.61	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of _____

Project Name ROSECHEM	Project No. 88-025-4	Hole No. MW-104
Location	Elev. Ground Surface (G.S.) 823.3	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 825.82	
Date Started Drilling Hole Time	Total Depth of Hole	Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer	Footage Slotted
Date Piezometer Installed Time		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/20/89	3:20 p	R. Slayden	22.97' from T.O.P.	802.85	Bailed dry
3/2/89	9:30a	D. Ballard	15.19' from T.O.P.	810.63	
3/8/89	8:50a	G. Nieman	13.48' from T.O.P.	812.34	Bailed 6 gallons; sampled 3/9/89
3/29/89	1:30p	M. Hildebrandt	13.27' from T.O.P.	812.55	
4/5/89	7:58a	G. Nieman	12.83' from T.O.P.	812.99	
4/11/89	2:20p	G. Nieman	12.68' from T.O.P.	813.14	Bailed 6 gals.
4/12/89	10:45a	G. Nieman	48.45' from T.O.P.	777.37	sampled
4/28/89	a	K. Smith	13.83' from T.O.P.	811.99	
5/5/89	12:39p	M. Hildebrandt	13.21' from T.O.P.	812.61	
5/12/89	15:38	J. Hollingsworth	12.93' from T.O.P.	812.89	
5/24/89	3:17p	M. Hildebrandt	12.73' from T.O.P.	813.09	
6/9/89	10:00a	M. Hildebrandt	12.92' from T.O.P.	812.90	Bailed dry; slug tested
6/20/89	9:05a	M. Hildebrandt	39.50' from T.O.P.	786.32	Sampled
6			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name: Rosechem	Project No: 88-025-4	Hole No.: MW-104
Location	Elev. Ground Surface (G.S.): 823.3	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.): 825.82	
Date Started Drilling Hole / Time	Total Depth of Hole / Drilling Type	
Date Completed Drilling Hole / Time		
Date Piezometer Installed / Time	Total Depth of Piezometer / Footage Slotted	

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6-29-89		J. Hollingsworth	18.38 from T.O.P.	807.44	
7-14-89		J. Hollingsworth	14.07 from T.O.P.	811.75	
7-20-89		J. Hollingsworth	14.06 from T.O.P.	811.76	
7-27-89		J. Hollingsworth	14.05 from T.O.P.	811.77	
8-14-89		J. Hollingsworth	14.06 from T.O.P.	811.76	
9-11-89		J. Hollingsworth	14.41 from T.O.P.	811.41	
10-2-89		J. Hollingsworth	14.90 from T.O.P.	810.92	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of ____

Project Name	ROSECHEM	Project No.	88-025-4	Hole No.	MW-105
Location				Elev. Ground Surface (G.S.)	834.1
N	E			Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.)	836.06
Date Started Drilling Hole		Time		Total Depth of Hole	Drilling Type
Date Completed Drilling Hole		Time			
Date Piezometer Installed		Time		Total Depth of Piezometer	Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/17/89	1:30p	R. Slayden	27.34' from T.O.P	808.72	
2/20/89	1:30p	R. Slayden	22.67' from T.O.P	813.39	Bailed dry
3/2/89	9:09a	D. Ballard	14.48 from T.O.P.	821.58	
3/6/89	2:42p	G. Nieman	13.81' from T.O.P.	822.25	Bailed
3/7/89	2:05p	G. Nieman	41.94' from T.O.P.	794.12	sampled
3/27/89	11:00a	M. Hildebrandt	13.47' from T.O.P.	822.59	Bailed dry
3/27/89	2:45p	M. Hildebrandt	48.45' from T.O.P.	787.61	
3/29/89	9:50a	M. Hildebrandt	32.56' from T.O.P.	803.50	Bailed dry
3/29/89	1:25p	M. Hildebrandt	49.69' from T.O.P.	786.37	
3/31/89	10:20a	M. Hildebrandt	33.25' from T.O.P.	802.81	Bailed dry
3/31/89	2:00p	M. Hildebrandt	49.65' from T.O.P.	786.41	
4/5/89	7:46a	G. Nieman	20.35' from T.O.P.	815.71	
4/6/89	7:55a	P. Clark	18.21' from T.O.P.	817.85	Bailed 5 gals.
4/6/89	2:30p	G. Nieman	48.66' from T.O.P.	787.40	sampled
4/28/89	a	K. Smith	13.57' from T.O.P.	822.49	
5/5/89	12:15p	M. Hildebrandt	13.38' from T.O.P.	822.68	

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name: ROSECHEM	Project No.: 88-025-4	Hole No.: MW-105
Location	Elev. Ground Surface (G.S.): 834.1	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.): 836.06	
Date Started Drilling Hole / Time	Total Depth of Hole / Drilling Type	
Date Completed Drilling Hole / Time		
Date Piezometer Installed / Time	Total Depth of Piezometer / Footage Slotted	

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev. (ft.)	Remarks
5/12/89	15:30	J. Hollingsworth	13.39' from T.O.P.	822.67	
5/24/89	3:21p	M. Hildebrandt	13.33' from T.O.P.	822.73	
6/16/89	8:30a	M. Hildebrandt	13.45' from T.O.P.	822.61	Bailed dry
6/21/89	9:05a	M. Hildebrandt	23.75' from T.O.P.	812.31	Bailed dry
6/22/89	12:15a	M. Hildebrandt	42.78' from T.O.P.	793.28	Sampled
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 3 of _____

Project Name	Project No	Hole No.
Rosechem	88-025-4	MW-105

Location	Elev. Ground Surface (G.S.) 834.1
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 836.06
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer Footage Slotted
Date Piezometer Installed Time	

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6-29-89		J. Hollingsworth	24.77 from T.O.P.	811.29	
7-14-89		J. Hollingsworth	14.43 from T.O.P.	821.63	
7-20-89		J. Hollingsworth	14.71 from T.O.P.	821.35	
7-27-89		J. Hollingsworth	14.60 from T.O.P.	821.46	
8-14-89		J. Hollingsworth	14.59 from T.O.P.	821.47	
9-11-89		J. Hollingsworth	14.58 from T.O.P.	821.48	
10-2-89		J. Hollingsworth	14.73 from T.O.P.	821.33	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of ____

Project Name ROSECHEM	Project No. 88-025-4	Hole No. MW-106
Location	Elev. Ground Surface (G.S.) 831.2	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 833.36	
Date Started Drilling Hole Time	Total Depth of Hole	Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer	Footage Slotted
Date Piezometer Installed Time		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/20/89	2:15p	R. Slayden	18.8' from T.O.P	814.56	Bailed dry
3/2/89	9:17a	D. Ballard	16.25' from T.O.P.	817.11	
3/6/89	1:10p	G. Nieman	14.86' from T.O.P.	818.50	Bailed dry
3/7/89	11:15a	G. Nieman	25.87' from T.O.P.	807.49	sampled
3/29/89	2:35p	M. Hildebrandt	14.49' from T.O.P.	818.87	
4/5/89	8:20a	G. Nieman	14.30' from T.O.P.	819.06	Bailed 2.5 gals (18:25p)
4/6/89	9:45a	G. Nieman	26.05' from T.O.P.	807.31	sampled
4/28/89	a	K. Smith	15.25' from T.O.P.	818.11	
5/5/89	12:04p	M. Hildebrandt	14.93' from T.O.P.	818.43	
5/12/89	16:34	J. Hollingsworth	14.90' from T.O.P.	818.46	
5/24/89	3:32p	M. Hildebrandt	14.83' from T.O.P.	818.53	
6/16/89	9:20a	M. Hildebrandt	14.75' from T.O.P.	818.61	Bailed dry
6/19/89	4:25p	M. Hildebrandt	22.65' from T.O.P.	810.71	Bailed dry
6/20/89	7:30a	M. Hildebrandt	26.62' from T.O.P.	806.74	Sampled
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name	Project No.	Hole No.
Rosechem	88-025-4	MW-106

Location	Elev. Ground Surface (G.S.) 831.2
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 833.36
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6-27-89		J. Hollingsworth	19.94 from T.O.P.	813.42	
7-14-89		J. Hollingsworth	14.52 from T.O.P.	818.84	
7-20-89		J. Hollingsworth	14.34 from T.O.P.	819.02	
7-27-89		J. Hollingsworth	13.56 from T.O.P.	819.80	
8-14-89		J. Hollingsworth	13.11 from T.O.P.	820.25	
9-11-89		J. Hollingsworth	11.9 from T.O.P.	821.46	
10-2-89		J. Hollingsworth	11.35 from T.O.P.	822.01	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of _____

Project Name ROSECHEM	Project No. 88-025-4	Hole No. MW-107
Location	Elev. Ground Surface (G.S.) 831.4	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 833.46	
Date Started Drilling Hole Time	Total Depth of Hole	Drilling Type
Date Completed Drilling Hole Time		
Date Piezometer Installed Time	Total Depth of Piezometer	Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/20/89	2:45p	R. Slayden	47.8' from T.O.P	785.66	Bailed dry
3/2/89	9:22a	D. Ballard	48.59' from T.O.P.	784.87	
3/8/89	9:00a	G. Nieman	48.31' from T.O.P.	785.15	Bailed 1 gallon; sampled 3/9
3/29/89	2:30p	M. Hildebrandt	48.46' from T.O.P.	785.00	
4/5/89	8:26a	G. Nieman	48.16' from T.O.P.	785.30	
4/7/89	12:45p	G. Nieman	48.05' from T.O.P.	785.41	Surged
4/8/89	8:00a	G. Nieman	48.19' from T.O.P.	785.27	Bailed dry (lgt.)
4/10/89	3:30p	G. Nieman	49.22' from T.O.P.	784.24	Bailed 1 cup.
4/11/89	2:00p	G. Nieman	49.53' from T.O.P.	783.93	
4/12/89	9:05a	G. Nieman	49.52' from T.O.P.	783.94	sampled VOA,
4/28/89	a	K. Smith	49.14' from T.O.P.	784.32	
5/5/89	12:00p	M. Hildebrandt	48.67' from T.O.P.	784.79	
5/12/89	15:55	J. Hollingsworth	48.29' from T.O.P.	785.17	
5/24/89	3:35p	M. Hildebrandt	47.77' from T.O.P.	785.69	
6/19/89	4:00p	M. Hildebrandt	46.68' from T.O.P.	786.78	Bailed dry
6/20/89	12:00p	M. Hildebrandt	48.89' from T.O.P.	784.57	Sampled

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
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Observed Water Level Readings

Sheet 2 of _____

Project Name: ROSE CHEM	Project No.: 88-025-4	Hole No.: MW-107
Location	Elev. Ground Surface (G.S.): 831.4	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.): 833.46	
Date Started Drilling Hole / Time	Total Depth of Hole / Drilling Type	
Date Completed Drilling Hole / Time	Total Depth of Piezometer / Footage Slotted	
Date Piezometer Installed / Time		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6/21/89	8:45a	M. Hildebrandt	49.75' from T.O.P.	783.71	Not enough water to sample
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
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Observed Water Level Readings

Sheet 3 of _____

Project Name	Project No	Hole No.
Rosechem	88-025-4	MW-107

Location	Elev. Ground Surface (G.S.) 831.4
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 833.46
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6-29-89		J. Hollingsworth	48.12 from T.O.P.	785.34	
7-14-89		J. Hollingsworth	48.61 from T.O.P.	784.85	
7-20-89		J. Hollingsworth	48.2 from T.O.P.	785.26	
7-27-89		J. Hollingsworth	47.7 from T.O.P.	785.76	
8-14-89		J. Hollingsworth	47.16 from T.O.P.	786.30	
9-11-89		J. Hollingsworth	45.24 from T.O.P.	788.22	
10-2-89		J. Hollingsworth	44.56 from T.O.P.	788.90	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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Observed Water Level Readings

Sheet 1 of ____

Project Name	ROSECHEM	Project No.	88-025-4	Hole No.	MW-108
Location		Elev. Ground Surface (G.S.)		826.0	
N	E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.)		828.27	
Date Started Drilling Hole	Time	Total Depth of Hole		Drilling Type	
Date Completed Drilling Hole	Time	Total Depth of Piezometer		Footage Slotted	
Date Piezometer Installed	Time				

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/20/89	4:00p	R. Slayden	18.36' from T.O.P.	809.91	Bailed dry
2/28/89	3:30p	D. Ballard	18.22' from T.O.P.	810.05	
3/2/89	9:04a	D. Ballard	18.09' from T.O.P.	810.18	
3/6/89	2:00p	G. Nieman	18.00' from T.O.P.	810.27	Bailed 6 gallons
3/7/89	7:20a	G. Nieman	33.67' from T.O.P.	794.60	sampled
3/27/89	1:30p	M. Hildebrandt	18.04' from T.O.P.	810.23	Bailed dry
3/27/89	2:35p	M. Hildebrandt	46.97' from T.O.P.	781.30	
3/29/89	10:30a	M. Hildebrandt	21.94' from T.O.P.	806.33	Bailed dry
3/29/89	2:25p	M. Hildebrandt	43.88' from T.O.P.	784.39	
3/31/89	11:10a	M. Hildebrandt	22.07' from T.O.P.	806.20	Bailed dry
3/31/89	1:50p	M. Hildebrandt	45.65' from T.O.P.	782.62	
4/5/89	8:30a	G. Nieman	19.39' from T.O.P.	808.88	
4/11/89	1:25p	G. Nieman	18.47' from T.O.P.	809.80	Bailed 5 gals.
4/12/89	7:30a	G. Nieman	30.57' from T.O.P.	797.70	sampled
4/28/89	a	K. Smith	18.61' from T.O.P.	809.66	
5/5/89	11:43a	M. Hildebrandt	18.41' from T.O.P.	809.86	

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name ROSECHEM	Project No. 88-025-4	Hole No. MW-108
Location	Elev. Ground Surface (G.S.) 826.0	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 828.27	
Date Started Drilling Hole Time	Total Depth of Hole	Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer	Footage Slotted
Date Piezometer Installed Time		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
5/12/89	16:17	J. Hollingsworth	18.49' from T.O.P.	809.78	
5/24/89	2:51p	M. Hildebrandt	18.24' from T.O.P.	810.03	
6/21/89	2:10p	M. Hildebrandt	18.48' from T.O.P.	809.79	Bailed dry
6/22/89	8:31a	M. Hildebrandt	32.15' from T.O.P.	796.12	Sampled
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 3 of _____

Project Name	Project No.	Hole No.
Rosechem	88-025-4	MW-108

Location	Elev. Ground Surface (G.S.) 826.0
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 828.27
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer Footage Slotted
Date Piezometer Installed Time	

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6-29-89		J. Hollingsworth	18.79 from T.O.P.	809.48	
7-14-89		J. Hollingsworth	19.08 from T.O.P.	809.19	
7-20-89		J. Hollingsworth	19.11 from T.O.P.	809.16	
7-27-89		J. Hollingsworth	19.21 from T.O.P.	809.06	
8-14-89		J. Hollingsworth	19.26 from T.O.P.	809.01	
9-11-89		J. Hollingsworth	19.17 from T.O.P.	809.10	
10-2-89		J. Hollingsworth	19.06 from T.O.P.	809.21	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of _____

Project Name ROSECHEM	Project No. 88-025-4	Hole No. MW-109
Location	Elev. Ground Surface (G.S.) 835.7	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 837.79	
Date Started Drilling Hole Time	Total Depth of Hole	Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer	Footage Slotted
Date Piezometer Installed Time		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/21/89	9:10a	R. Slayden	39.36' from T.O.P	798.43	Bailed dry
2/28/89	11:10a	R. Slayden	38.95' from T.O.P	798.84	Bailed dry, sampled
3/2/89	8:52a	D. Ballard	42.64' from T.O.P.	795.15	
3/8/89	9:10a	G. Nieman	39.37' from T.O.P.	798.42	Bailed dry; sampled 3/9/89
3/27/89	1:00p	M. Hildebrandt	33.34' from T.O.P.	804.45	Bailed dry
3/27/89	2:45p	M. Hildebrandt	42.15' from T.O.P.	795.64	
3/29/89	11:30a	M. Hildebrandt	41.26' from T.O.P.	796.53	Bailed dry
3/29/89	2:16p	M. Hildebrandt	42.79' from T.O.P.	795.00	
3/31/89	11:50a	M. Hildebrandt	41.76' from T.O.P.	796.03	Bailed dry
3/31/89	1:10p	M. Hildebrandt	43.14' from T.O.P.	794.65	
4/5/89	8:40a	G. Nieman	40.84' from T.O.P.	796.95	
4/7/89	1:45p	G. Nieman	39.88' from T.O.P.	797.91	Surged Well
4/8/89	7:30a	G. Nieman	41.65' from T.O.P.	796.14	Bailed dry (1gl.)
4/10/89	3:00p	G. Nieman	41.32' from T.O.P.	796.47	Bailed 1.5 gals.
4/11/89	3:20p	G. Nieman	42.19' from T.O.P.	795.60	Bailed 1c.
4/12/89	10:30a	G. Nieman	42.50' from T.O.P.	795.29	sampled

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name ROSECHEM	Project No. 88-025-4	Hole No. MW-109
Location	Elev. Ground Surface (G.S.) 835.7'	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 837.79'	
Date Started Drilling Hole Time	Total Depth of Hole	Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer	Footage Slotted
Date Piezometer Installed Time		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
4/28/89	a	K. Smith	32.67' from T.O.P.	805.12	
5/5/89	11:38a	M. Hildebrandt	28.87' from T.O.P.	808.92	
5/12/89	17:05	J. Hollingsworth	25.74' from T.O.P.	812.05	
5/24/89	3:45p	M. Hildebrandt	22.82' from T.O.P.	814.97	
6/20/89	1:38p	M. Hildebrandt	19.52' from T.O.P.	818.27	Bailed dry
6/21/89	8:05a	M. Hildebrandt	43.17' from T.O.P.	794.62	Sampled
6/22/89	1:07p	M. Hildebrandt	42.40' from T.O.P.	795.39	Sampled
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 3 of _____

Project Name: Rosechem	Project No.: 88-025-4	Hole No.: MW-109
Location	Elev. Ground Surface (G.S.): 835.7	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.): 837.79	
Date Started Drilling Hole / Time	Total Depth of Hole / Drilling Type	
Date Completed Drilling Hole / Time	Total Depth of Piezometer / Footage Slotted	
Date Piezometer Installed / Time		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
7-14-89		J. Hollingsworth	29.17 from T.O.P.	808.62	
7-20-89		J. Hollingsworth	26.38 from T.O.P.	811.41	
7-27-89		J. Hollingsworth	23.96 from T.O.P.	813.83	
8-14-89		J. Hollingsworth	21.30 from T.O.P.	816.49	
9-11-89		J. Hollingsworth	19.22 from T.O.P.	818.57	
10-2-89		J. Hollingsworth	18.53 from T.O.P.	819.26	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of _____

Project Name ROSECHEM	Project No. 88-025-4	Hole No. MW-110
Location	Elev. Ground Surface (G.S.)	836.3
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.)	838.63
Date Started Drilling Hole Time	Total Depth of Hole	Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer	Footage Slotted
Date Piezometer Installed Time		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/21/89	8:30a	R. Slayden	14.31' from T.O.P	824.32	Bailed dry
2/24/89	8:00a	" "	14.54' from T.O.P.	824.09	Bailed dry (2.5 gal.) sampled
3/2/89	8:37a	D. Ballard	14.30' from T.O.P.	824.33	
3/8/89	9:20a	G. Nieman	14.17' from T.O.P.	824.46	
3/29/89	2:10p	M. Hildebrandt	13.34' from T.O.P.	825.29	
4/5/89	8:42a	G. Nieman	12.83' from T.O.P.	825.80	Bailed dry (3 gals.); sampled
4/28/89	a	K. Smith	13.02' from T.O.P.	825.61	
5/5/89	11:25a	M. Hildebrandt	13.23' from T.O.P.	825.40	
5/12/89	16:25	J. Hollingsworth	13.54' from T.O.P.	825.09	
5/24/89	2:34p	M. Hildebrandt	12.20' from T.O.P.	826.43	
6/15/89	6:30a	G. Nieman	12.44' from T.O.P.	826.19	Bailed dry (3 gal); sampled
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name	Rose chem	Project No.	88-625-4	Hole No.	MW-110
Location		Elev. Ground Surface (G.S.)	836.3		
N	E	Elev. Top of Pipe (T.O.P.) or Reference Point (R.P.)	838.63		
Date Started Drilling Hole	Time	Total Depth of Hole		Drilling Type	
Date Completed Drilling Hole	Time	Total Depth of Piezometer		Footage Slotted	
Date Piezometer Installed	Time				

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
7-14-89		J. Hollingsworth	12.86 from T.O.P.	825.77	
7-20-89		J. Hollingsworth	12.94 from T.O.P.	825.69	
7-27-89		J. Hollingsworth	13.17 from T.O.P.	825.46	
8-14-89		J. Hollingsworth	13.42 from T.O.P.	825.21	
9-11-89		J. Hollingsworth	13.00 from T.O.P.	825.63	
10-2-89		J. Hollingsworth	12.24 from T.O.P.	826.39	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of _____

Project Name ROSECHEM	Project No. 88-025-4	Hole No. MW-111
Location	Elev. Ground Surface (G.S.) 815.4	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 817.07	
Date Started Drilling Hole Time	Total Depth of Hole	Drilling Type
Date Completed Drilling Hole Time		
Date Piezometer Installed Time	Total Depth of Piezometer	Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/17/89	10:30a	R. Slayden	5.52' from T.O.P	811.55	
2/21/89	9:45a	" "	6.56' from T.O.P	810.51	
~~2/24/89~~			from		
3/2/89	9:52a	D. Ballard	6.18' from T.O.P.	810.89	
3/2/89	11:15a	D. Ballard	6.11' from T.O.P.	810.96	Bailed dry (6gal) sampled
3/8/89	10:05a	G. Nieman	6.84' from T.O.P.	810.23	
3/29/89	1:46p	M. Hildebrandt	6.28' from T.O.P.	810.79	
4/5/89	8:16a	G. Nieman	6.46' from T.O.P.	810.61	
4/11/89	8:15a	G. Nieman	6.47' from T.O.P.	810.60	Bailed dry
4/11/89	11:00a	G. Nieman	35.08' from T.O.P.	781.99	sampled
4/28/89	a	K. Smith	7.02' from T.O.P.	810.05	
5/5/89	12:24p	M. Hildebrandt	7.96' from T.O.P.	809.11	
5/12/89	16:11	J. Hollingsworth	7.13' from T.O.P.	809.94	
5/24/89	4:00p	M. Hildebrandt	7.01' from T.O.P.	810.06	
6/21/89	10:20a	M. Hildebrandt	7.34' from T.O.P.	809.73	Bailed dry
6/22/89	11:07a	M. Hildebrandt	15.58' from T.O.P.	801.49	Sampled

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name	Project No.	Hole No.
Rosechem	88-025-4	MW-111

Location	Elev. Ground Surface (G.S.) 815.4
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 817.07
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer Footage Slotted
Date Piezometer Installed Time	

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
7-14-89		J. Hollingsworth	8.20 from T.O.P.	808.87	
7-20-89		J. Hollingsworth	8.20 from T.O.P.	808.87	
7-27-89		J. Hollingsworth	8.0 from T.O.P.	809.07	
8-14-89		J. Hollingsworth	8.0 from T.O.P.	809.07	
9-11-89		J. Hollingsworth	7.91 from T.O.P.	809.16	
10-2-89		J. Hollingsworth	7.42 from T.O.P.	809.65	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of _____

Project Name	ROSECHEM	Project No.	88-025-4	Hole No.	MW-201
Location				Elev. Ground Surface (G.S.)	818.6
N	E			Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.)	820.64
Date Started Drilling Hole		Time		Total Depth of Hole	Drilling Type
Date Completed Drilling Hole		Time			
Date Piezometer Installed		Time		Total Depth of Piezometer	Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev. (ft.)	Remarks
2/16/89	8:10a	R. Slayden	7.48' from T.O.P	813.16	
2/21/89	4:30p	" "	7.76 from T.O.P	812.88	Bailed 3 gallons.
3/2/89	9:48a	D. Ballard	9.32' from T.O.P.	811.32	
3/3/89	9:36a	D. Ballard	9.32' from TOP.	811.32	Bailed dry (4.5g)
3/6/89	12:46p	G. Nieman	12.26' from T.O.P.	808.38	Bailed dry (2.5 gallons)
3/7/89	10:00a	G. Nieman	13.25' from T.O.P.	807.39	sampled
3/29/89	1:38p	M. Hildebrandt	7.31' from T.O.P.	813.33	
4/5/89	8:02a	G. Nieman	5.61' from T.O.P.	815.03	
4/10/89	9:30a	G. Nieman	6.95' from T.O.P.	813.69	Bailed 3.5 gals.
4/10/89	1:30p	G. Nieman	13.15' from T.O.P.	807.49	sampled
4/28/89	a	K. Smith	10.05' from T.O.P.	810.59	
5/5/89	12:31p	M. Hildebrandt	9.56' from T.O.P.	811.08	
5/12/89	15:45p	J. Hollingsworth	6.54' from T.O.P.	814.10	
5/24/89	3:10p	M. Hildebrandt	5.82' from T.O.P.	814.82	
6/19/89	2:10p	M. Hildebrandt	4.21' from T.O.P.	816.43	Bailed dry
6/20/89	9:55a	M. Hildebrandt	11.20' from T.O.P.	809.44	Sampled

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Project Name: Rosechem	Project No.: 88-025-4	Hole No.: MW-201
Location	Elev. Ground Surface (G.S.): 818.6	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.): 820.64	
Date Started Drilling Hole / Time	Total Depth of Hole / Drilling Type	
Date Completed Drilling Hole / Time	Total Depth of Piezometer / Footage Slotted	
Date Piezometer Installed / Time		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6-29-89		J. Hollingsworth	10.71 from T.O.P.	809.93	
7-14-89		J. Hollingsworth	9.64 from T.O.P.	811.00	
7-20-89		J. Hollingsworth	9.78 from T.O.P.	810.86	
7-27-89		J. Hollingsworth	9.81 from T.O.P.	810.83	
8-14-89		J. Hollingsworth	9.94 from T.O.P.	810.70	
9-11-89		J. Hollingsworth	9.71 from T.O.P.	810.93	
10-2-89		J. Hollingsworth	9.53 from T.O.P.	811.11	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of ____

Project Name	Project No.	Hole No.
ROSECHEM	88-025-4	MW-202

Location	Elev. Ground Surface (G.S.) 829.4
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 832.20
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/16/89	8:32a	R. Slayden	9.31' from T.O.P	822.89	
2/21/89	10:50a	" "	8.91' from T.O.P.	823.29	Bailed dry
2/24/89	9:40a	R. Slayden	9.23' from T.O.P.	822.97	Bailed 7 gallons, sampled
3/2/89	8:48a	D. Ballard	9.00' from T.O.P.	823.20	
3/8/89	9:25a	G. Nieman	9.08' from T.O.P.	823.12	
3/27/89	2:03p	M. Hildebrandt	8.54' from T.O.P.	823.66	
4/5/89	8:52a	G. Nieman	8.58' from T.O.P.	823.62	Bailed 7gals.; sampled
4/28/89	a	K. Smith	8.10' from T.O.P.	824.10	
5/5/89	11:30a	M. Hildebrandt	8.15' from T.O.P.	824.05	
5/12/89	16:50	J. Hollingsworth	8.23' from T.O.P.	823.97	
5/24/89	2:45p	M. Hildebrandt	7.58' from T.O.P.	824.62	
6/5/89	9:50a	G. Nieman	7.40' from T.O.P.	824.80	Bailed 8gals, sampled
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name	Project No.	Hole No.
Rosechem	88-025-4	MW-202

Location	Elev. Ground Surface (G.S.) 829.4
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 832.20
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6-29-89		J. Hollisworth	8.11 from T.O.P.	824.09	
7-14-89		J. Hollisworth	7.25 from T.O.P.	824.95	
7-20-89		J. Hollisworth	7.41 from T.O.P.	824.79	
7-27-89		J. Hollisworth	7.58 from T.O.P.	824.62	
8-14-89		J. Hollisworth	7.60 from T.O.P.	824.60	
9-11-89		J. Hollisworth	7.24 from T.O.P.	824.96	
10-2-89		J. Hollisworth	7.16 from T.O.P.	825.04	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
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Observed Water Level Readings

Sheet 1 of ____

Project Name	Project No.	Hole No.
ROSECHEM	88-025-4	MW-203

Location	Elev. Ground Surface (G.S.) 812.5
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 814.21
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/16/89	8:20a	R. Slayden	3.75' from T.O.P	810.46	
2/21/89	2:30p	" "	4.00' from T.O.P.	810.21	Bailed
3/1/89	2:15p	D. Ballard	3.95' from TOP	810.26	Bailed 8 gal., sampled
3/2/89	10:06pa	D. Ballard	3.99' from T.O.P.	810.22	
3/8/89	9:45a	G. Nieman	3.91' from T.O.P.	810.30	
3/27/89	1:53p	M. Hildebrandt	3.74' from T.O.P.	810.47	
4/5/89	8:09a	G. Nieman	3.53' from T.O.P.	810.68	
4/10/89	10:30a	G. Nieman	3.55' from T.O.P.	810.66	Bailed dry (10 gals); sampled
4/28/89	a	K. Smith	4.82' from T.O.P.	809.39	
5/5/89	11:50a	M. Hildebrandt	4.98' from T.O.P.	809.23	
5/12/89	16:01	J. Hollingsworth	5.24' from T.O.P.	808.97	
6/24/89	3:00p	M. Hildebrandt	3.29' from T.O.P.	810.92	
6/21/89	11:50a	M. Hildebrandt	3.55' from T.O.P.	810.66	Bailed (6 gals.); sampled
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name	Project No	Hole No.
Rosechem	88-025-41	MW-203

Location	Elev. Ground Surface (G.S.) 812.5
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 814.21
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6-29-89		J. Hollingsworth	4.99 from T.O.P.	809.22	
7-14-89		J. Hollingsworth	4.84 from T.O.P.	809.37	
7-20-89		J. Hollingsworth	4.89 from T.O.P.	809.32	
7-27-89		J. Hollingsworth	4.92 from T.O.P.	809.29	
8-14-89		J. Hollingsworth	5.68 from T.O.P.	808.53	
9-11-89		J. Hollingsworth	4.42 from T.O.P.	809.79	
10-2-89		J. Hollingsworth	4.19 from T.O.P.	810.02	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of _____

Project Name ROSECHEM	Project No. 88-025-4	Hole No. MW-204
Location	Elev. Ground Surface (G.S.) 823.8	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 825.70	
Date Started Drilling Hole Time	Total Depth of Hole	Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer	Footage Slotted
Date Piezometer Installed Time		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/16/89	3:35p	R. Slayden	5.86' from T.O.P	819.84	
2/17/89	2:17p	" "	6.16' from T.O.P.	819.54	
2/22/89	10:15a	" "	5.96' from T.O.P.	819.74	
3/2/89	9:33a	D. Ballard	5.88' from T.O.P.	819.82	
3/8/89	8:55a	G. Nieman	5.73' from T.O.P.	819.97	Bailed ½ gallon; sampled 3-9
3/29/89	1:30p	M. Hildebrandt	5.54' from T.O.P.	820.16	
4/5/89	8:00a	G. Nieman	5.31' from T.O.P.	820.39	
4/11/89	3:00p	G. Nieman	5.07' from T.O.P.	820.63	Bailed 1gt.
4/12/89	11:20a	G. Nieman	5.68' from T.O.P.	820.02	sampled VOC,
4/28/89	a	K. Smith	5.46' from T.O.P.	820.24	
5/5/89	12:37p	M. Hildebrandt	5.33' from T.O.P.	820.37	
5/12/89	15:40	J. Hollingsworth	5.35' from T.O.P.	820.35	
5/24/89	3:15p	M. Hildebrandt	5.23' from T.O.P.	820.47	
6/20/89	8:00a	M. Hildebrandt	4.89' from T.O.P.	820.81	Bailed; sampled
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name	Project No.	Hole No.
Rosechem	88-025-4	MW-204

Location	Elev. Ground Surface (G.S.) 823.8
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 825.7
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6·29·89		J. HOLLINGSWORTH	5.01 from T.O.P.	820.69	
7·14·89		J. HOLLINGSWORTH	5.59 from T.O.P.	820.11	
7·20·89		J. HOLLINGSWORTH	5.61 from T.O.P.	820.09	
7·27·89		J. HOLLINGSWORTH	5.62 from T.O.P.	820.08	
8·14·89		J. HOLLINGSWORTH	~~4.52~~ 5.68 from T.O.P.	820.02	
9·11·89		J. HOLLINGSWORTH	5.98 from T.O.P.	819.72	
10·2·89		J. HOLLINGSWORTH	4.75 from T.O.P.	820.95	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of ____

Project Name	Project No.	Hole No.
ROSECHEM	88-025-4	MW-205

Location	Elev. Ground Surface (G.S.) 834.3
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 836.13
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/15/89	9:45a	R. Slayden	11.08' from T.O.P	825.05	
2/17/89	2:10p	" "	11.07' from T.O.P.	825.06	
2/22/89	8:00a	" "	11.02' from T.O.P.	825.11	Bailed 2.5 gallons.
3/2/89	9:15a	D. Ballard	10.56' from T.O.P.	825.57	
3/6/89	3:20p	G. Nieman	10.70' from T.O.P.	825.43	Bailed
3/7/89	3:00p	G. Nieman	10.78' from T.O.P.	825.35	sampled
3/29/89	1:27p	M. Hildebrandt	10.16' from T.O.P.	825.97	
4/5/89	7:50a	G. Nieman	10.25' from T.O.P.	825.88	
4/6/89	8:45a	P. Clark	9.97' from T.O.P.	826.16	Bailed 2 gals.
4/6/89	1:17p	P. Clark	9.97' from T.O.P.	826.16	sampled
4/28/89	[illegible] a	K. Smith	9.83' from T.O.P.	826.30	
5/5/89	12:11p	M. Hildebrandt	9.92' from T.O.P.	826.21	
5/12/89	15:32	J. Hollingsworth	9.83' from T.O.P.	826.30	
5/24/89	3:24p	M. Hildebrandt	9.19' from T.O.P.	826.94	
6/16/89	9:00a	M. Hildebrandt	9.20' from T.O.P.	826.93	Bailed dry; sampled
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name	Project No.	Hole No.
Rosechem	88-025-4	MW-205

Location	Elev. Ground Surface (G.S.) 834.3
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 836.13
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer Footage Slotted
Date Piezometer Installed Time	

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6-29-89		J. Hollingsworth	9.2 from T.O.P.	826.93	
7-14-89		J. Hollingsworth	9.22 from T.O.P.	826.91	
7-20-89		J. Hollingsworth	9.29 from T.O.P.	826.84	
7-27-89		J. Hollingsworth	9.34 from T.O.P.	826.79	
8-14-89		J. Hollingsworth	9.52 from T.O.P.	826.61	
9-11-89		J. Hollingsworth	9.31 from T.O.P.	826.82	
10-2-89		J. Hollingsworth	9.12 from T.O.P.	827.01	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

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GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of ____

Project Name	Project No.	Hole No.
ROSECHEM	88-025-4	MW-206

Location	Elev. Ground Surface (G.S.) 831.0
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 832.86
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer Footage Slotted
Date Piezometer Installed Time	

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/15/89	1:00p	R. Slayden	10.36' from T.O.P	822.50	
2/22/89	9:00a	" "	10.24' from T.O.P	822.62	Bailed 2 gallons
3/2/89	9:20a	D. Ballard	9.93' from T.O.P.	822.93	
3/6/89	1:40p	G. Nieman	9.97' from T.O.P.	822.89	Bailed 3 gallons
3/7/89	12:45p	G. Nieman	10.10' from T.O.P.	822.76	sampled
3/29/89	2:35p	M. Hildebrandt	9.59' from T.O.P.	823.27	
4/5/89	8:22a	G. Nieman	9.51' from T.O.P.	823.35	Bailed 7 (8.41p) gallons; sampled 4/6/89
4/28/89	a	K. Smith	9.44' from T.O.P.	823.42	
5/5/89	12:06p	M. Hildebrandt	9.29' from T.O.P	823.57	
5/12/89	16:36	J. Hollingsworth	9.31' from T.O.P.	823.55	
5/24/89	3:29p	M. Hildebrandt	8.55' from T.O.P.	824.31	
6/16/89	10:04a	M. Hildebrandt	8.80' from T.O.P.	824.06	Bailed dry, sampled
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name	Project No	Hole No.
Rosechem	88-025-4	MW-206

Location	Elev. Ground Surface (G.S.) 831.0
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 832.86
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer Footage Slotted
Date Piezometer Installed Time	

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6-29-89		J. HOLLINGSWORTH	8.78 from T.O.P.	824.08	
7-14-89		J. HOLLINGSWORTH	8.7 from T.O.P.	824.16	
7-20-89		J. HOLLINGSWORTH	8.81 from T.O.P.	824.05	
7-27-89		J. HOLLINGSWORTH	8.89 from T.O.P.	823.97	
8-14-89		J. HOLLINGSWORTH	8.99 from T.O.P.	823.87	
9-1-89		J. HOLLINGSWORTH	8.93 from T.O.P.	823.93	
10-2-89		J. HOLLINGSWORTH	8.92 from T.O.P.	823.94	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of ____

Project Name ROSECHEM	Project No. 88-025-4	Hole No. MW-207
Location	Elev. Ground Surface (G.S.) 831.3	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 833.59	
Date Started Drilling Hole Time	Total Depth of Hole	Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer	Footage Slotted
Date Piezometer Installed Time		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/15/89	3:30p	R. Slayden	12.24' from T.O.P	821.35	
2/22/89	9:45a	" "	12.26' from T.O.P	821.33	
3/2/89	9:25a	D. Ballard	12.09' from T.O.P.	821.50	
3/8/89	9:03a	G. Nieman	12.02' from T.O.P.	821.57	Bailed 1 gallon; sampled 3-9-89
3/29/89	2:30p	M. Hildebrandt	11.73' from T.O.P.	821.86	
4/5/89	8:29a	G. Nieman	11.50' from T.O.P.	822.09	
4/11/89	2:10p	G. Nieman	11.40' from T.O.P.	822.19	Bailed dry (1.5 gals)
4/12/89	9:30a	G. Nieman	12.56' from T.O.P.	821.03	sampled
4/28/89	a	K. Smith	11.22' from T.O.P.	822.37	
5/5/89	11:58a	M. Hildebrandt	11.12' from T.O.P.	822.47	
5/12/89	15:52	J. Hollingsworth	11.21' from T.O.P.	822.38	
5/24/89	3:37p	M. Hildebrandt	10.64' from T.O.P.	822.95	
6/16/89	10:27a	M. Hildebrandt	10.55' from T.O.P.	823.04	Bailed dry
6/19/89	4:15p	M. Hildebrandt	11.98 from T.O.P.	821.61	Bailed dry
6/20/89	12:45p	M. Hildebrandt	11.89 from T.O.P.	821.70	Sampled
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name	Project No.	Hole No.
Rosechem	88-025-4	MW-207

Location	Elev. Ground Surface (G.S.) 831.3
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 833.59
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
6-29-89		J. Hollingsworth	11.47 from T.O.P.	822.12	
7-14-89		J. Hollingsworth	10.48 from T.O.P.	823.11	
7-20-89		J. Hollingsworth	10.50 from T.O.P.	823.09	
7-27-89		J. Hollingsworth	10.61 from T.O.P.	822.98	
8-14-89		J. Hollingsworth	10.80 from T.O.P.	822.79	
9-11-89		J. Hollingsworth	10.56 from T.O.P.	823.03	
10-2-89		J. Hollingsworth	10.48 from T.O.P.	823.11	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
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Observed Water Level Readings

Sheet 1 of ____

Project Name	Project No.	Hole No.
ROSECITEM	88-025-4	MW-208

Location	Elev. Ground Surface (G.S.) 825.3
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 827.16
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/16/89	10:20a	R. Slayden	Dry from T.O.P.	—	
2/22/89	2:30p	" "	Dry from T.O.P.	—	
2/28/89	11:40a	" "	Dry from T.O.P.	—	
3/2/89	9:06a	D. Ballard	Dry from T.O.P.	—	
3/29/89	2:25p	M. Hildebrandt	9.21' from T.O.P.	817.95	
4/5/89	8:38a	G. Nieman	8.84' from T.O.P.	818.32	
4/11/89	1:50p	G. Nieman	8.35' from T.O.P.	818.81	Bailed dry (1 gl.)
4/12/89	8:50a	G. Nieman	8.58' from T.O.P.	818.58	sampled
4/28/89	a	K. Smith	7.13' from T.O.P.	820.03	
5/5/89	11:45a	M. Hildebrandt	7.97' from T.O.P.	819.19	
5/12/89	16:19	J. Hollingsworth	7.00' from T.O.P.	820.16	
5/24/89	2:54p	M. Hildebrandt	6.92' from T.O.P.	820.24	
6/21/89	2:45p	M. Hildebrandt	6.83' from T.O.P.	820.33	Bailed dry
6/22/89	9:10a	M. Hildebrandt	9:10a from T.O.P.	818.06	sampled
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
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Observed Water Level Readings

Sheet 2 of _____

Project Name	Project No.	Hole No.
Rosechem	88-025-4	MW-208

Location	Elev. Ground Surface (G.S.) 825.3
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 827.16
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
7-14-89		J. HOLLINGSWORTH	7.9 from T.O.P.	819.26	
7-20-89		J. HOLLINGSWORTH	7.71 from T.O.P.	819.45	
7-27-89		J. HOLLINGSWORTH	7.58 from T.O.P.	819.58	
8-14-89		J. HOLLINGSWORTH	7.15 from T.O.P.	820.01	
9-11-89		J. HOLLINGSWORTH	7.11 from T.O.P.	820.05	
10-2-89		J. HOLLINGSWORTH	7.03 from T.O.P.	820.13	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
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Observed Water Level Readings

Sheet 1 of _____

Project Name: ROSECHEM	Project No.: 88-025-4	Hole No.: MW-209
Location	Elev. Ground Surface (G.S.): 835.9	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.): 837.67	
Date Started Drilling Hole / Time	Total Depth of Hole / Drilling Type	
Date Completed Drilling Hole / Time		
Date Piezometer Installed / Time	Total Depth of Piezometer / Footage Slotted	

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/16/89	1:00p	R. Slayden	14.74' from T.O.P	822.93	
2/22/89	10:45a	" "	14.95' from T.O.P	822.72	
3/1/89	10:45a	D. Ballard	15.61' from T.O.P.	822.06	bailed dry
3/2/89	8:59a	D. Ballard	15.66' from T.O.P.	822.01	
3/8/89	9:13a	G. Nieman	14.73' from T.O.P.	822.94	Bailed Dry; sampled 3/9/89
3/29/89	2:16p	M. Hildebrandt	14.13' from T.O.P.	823.54	
4/5/89	8:42a	G. Nieman	14.06' from T.O.P.	823.61	
4/10/89	3:20p	G. Nieman	14.01' from T.O.P.	823.66	Bailed 1gal.
4/11/89	9:10a	G. Nieman	14.65' from T.O.P.	823.02	sampled
4/28/89	a	K. Smith	13.31' from T.O.P.	824.36	
5/5/89	11:35a	M. Hildebrandt	13.19' from T.O.P.	824.48	
5/12/89	17:10	J. Hollingsworth	13.18' from T.O.P.	824.49	
5/24/89	3:42p	M. Hildebrandt	12.53' from T.O.P.	825.14	
6/20/89	2:15p	M. Hildebrandt	12.08' from T.O.P.	825.59	Bailed dry
6/21/89	7:15p	M. Hildebrandt	from		Sampled
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name	Project No.	Hole No.
Rosecrem	88-025-4	MW-209

Location	Elev. Ground Surface (G.S.) 835.9
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 837.67
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer Footage Slotted
Date Piezometer Installed Time	

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
7.14.89		J. Hollingsworth	12.11 from T.O.P.	825.56	
7.20.89		J. Hollingsworth	12.33 from T.O.P.	825.34	
7.27.89		J. Hollingsworth	12.41 from T.O.P.	825.26	
8.14.89		J. Hollingsworth	12.51 from T.O.P.	825.16	
9.11.89		J. Hollingsworth	12.18 from T.O.P.	825.49	
10.2.89		J. Hollingsworth	12.12 from T.O.P.	825.55	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of ____

Project Name ROSECHEM	Project No. 88-025-4	Hole No. MW-210
Location	Elev. Ground Surface (G.S.) 836.0	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 838.10	
Date Started Drilling Hole Time	Total Depth of Hole	Drilling Type
Date Completed Drilling Hole Time	Total Depth of Piezometer	Footage Slotted
Date Piezometer Installed Time		

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/17/89	9:00a	R. Slayden	14.4' from T.O.P.	823.70	
21221 89	12:45 p	" "	14.03' from T.O.P.	824.07	Bailed dry
2128/89	10:30a	R. Slayden	13.60' from T.O.P.	824.50	Bailed dry (2 gal.) sampled
3/2/89	8:31a	D. Ballard	13.98 from T.O.P.	824.12	
3/8/89	9:23a	G. Nieman	13.50' from T.O.P.	824.60	
3/29/89	2:10p	M. Hildebrandt	12.42' from T.O.P.	825.68	
4/5/89	9:00a	G. Nieman	12.24' from T.O.P.	825.86	Bailed 2 gals. (at 3:10p)
4/6/89	10:33a	P. Clark	11.85' from T.O.P.	826.25	sampled
4/28/89	a	K. Smith	12.15' from T.O.P.	825.95	
5/5/89	11:23a	M. Hildebrandt	12.50' from T.O.P.	825.60	
5/12/89	16:28	J. Hollingsworth	12.75' from T.O.P.	825.35	
5/24/89	2:30p	M. Hildebrandt	11.42' from T.O.P.	826.68	
6/15/89	8:20a	G. Nieman	11.76' from T.O.P.	826.34	Bailed 2.5 gals; sampled
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name Rosechem	Project No. 88-025-4	Hole No. MW-210
Location N E	Elev. Ground Surface (G.S.) 836.0 Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 838.10	
Date Started Drilling Hole Time Date Completed Drilling Hole Time Date Piezometer Installed Time	Total Depth of Hole Drilling Type Total Depth of Piezometer Footage Slotted	

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
7-14-89		J. Hollingsworth	12.18 from T.O.P.	825.92	
7-20-89		J. Hollingsworth	12.57 from T.O.P.	825.53	
7-27-89		J. Hollingsworth	12.71 from T.O.P.	825.39	
8-14-89		J. Hollingsworth	12.91 from T.O.P.	825.19	
9-11-89		J. Hollingsworth	12.10 from T.O.P.	826.00	
10-2-89		J. Hollingsworth	11.93 from T.O.P.	826.17	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 1 of ____

Project Name ROSECHEM	Project No. 88-025-4	Hole No. MW-211
Location	Elev. Ground Surface (G.S.) 815.1	
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 817.46	
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type	
Date Completed Drilling Hole Time		
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted	

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
2/21/89	1:00p	R. Slayden	10.26' from T.O.P	807.20	Bailed dry
2/22/89	1:45p	" "	10.28' from T.O.P	807.18	Bailed 3 galbns.
3/2/89	10:27a	D. Ballard	10.27' from T.O.P.	807.19	
3/2/89	2:30 p	D. Ballard	10.27' from T.O.P	807.19	Bailed dry (3.5gal) sampled 3/3/89
3/8/89	10:05a	G. Nieman	10.28' from T.O.P.	807.18	
3/29/89	1:46p	M. Hildebrandt	9.62' from T.O.P.	807.84	
4/5/89	8:14a	G. Nieman	8.90' from T.O.P.	808.56	
4/11/89	8:40a	G. Nieman	9.94' from T.O.P.	807.52	Bailed dry
4/11/89	9:40a	G. Nieman	12.35' from T.O.P.	805.11	
4/28/89	a	K. Smith	10.55' from T.O.P.	806.91	
5/5/89	12:25p	M. Hildebrandt	10.60' from T.O.P.	806.86	
5/12/89	16:13	J. Hollingsworth	10.87' from T.O.P.	806.59	
5/24/89	4:02p	M. Hildebrandt	9.00' from T.O.P.	808.46	
6/21/89	9:50a	M. Hildebrandt	10.36' from T.O.P.	807.10	Bailed dry
6/22/89	10:30a	M. Hildebrandt	10.57' from T.O.P	806.89	Sampled
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

TECHNICAL SERVICES
GEOTECHNICAL DEPARTMENT

Observed Water Level Readings

Sheet 2 of _____

Project Name	Project No.	Hole No.
Rosecham	88-025-4	MW-21

Location	Elev. Ground Surface (G.S.) 815.1
N E	Elev. Top at Pipe (T.O.P.) or Reference Point (R.P.) 817.46
Date Started Drilling Hole Time	Total Depth of Hole Drilling Type
Date Completed Drilling Hole Time	
Date Piezometer Installed Time	Total Depth of Piezometer Footage Slotted

Remarks:

Date	Time	By Whom	Depth to Water*	W.L. Elev.	Remarks
7-14-89		J. Hollingsworth	11.81 from T.O.P.	805.65	
7-20-89		J. Hollingsworth	11.84 from T.O.P.	805.62	
7-27-89		J. Hollingsworth	11.87 from T.O.P.	805.59	
8-14-89		J. Hollingsworth	11.92 from T.O.P.	805.54	
9-11-89		J. Hollingsworth	11.67 from T.O.P.	805.79	
10-2-89		J. Hollingsworth	11.14 from T.O.P.	806.32	
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		
			from		

*Depth to water noted from Ground Surface (G.S.), Top of Pipe (T.O.P.), or Reference Point (R.P.).

APPENDIX C - pH READINGS FOR MONITORING WELLS

Monitoring Well MW-101

Date	Time	pH	Comments
2/21	3:35p	9.46	Initial pH
	3:50p	9.49	After bailing 5 gallons
	4:15p	8.45	After bailing dry
3/7	10:30p	8.57	After sampling, Round 1 bailed dry 3/6
4/10	8:30a	8.01	After bailing dry (10 gallons)
	2:05p	8.37	Before sampling
	3:00p	8.42	After sampling, Round 2
6/19	2:35a	8.38	After bailing
6/20	10:30a	8.17	Before sampling
	10:48a	8.22	After sampling, Round 3

Monitoring Well MW-102

Date	Time	pH	Comments
2/20	11:15a	11.86	Initial pH
	11:55a	6.76	After bailing dry (12 gallons)
2/24	11:40a	6.55	After bailing dry
	2:45p	6.35	After sampling, Round 1
4/5	9:36a	7.53	Initial pH, bailed 10 gallons to dry
	1:30p	6.54	Before sampling
	2:15p	6.56	After sampling, Round 2
6/15	11:15a	6.90	Before sampling
	11:30a	7.00	After sampling, Round 3

Monitoring Well MW-103

Date	Time	pH	Comments
2/21	1:50p	10.36	Initial pH
	2:15p	10.31	After bailing 5 gallons
	2:25p	10.10	After bailing 5 gallons
3/2	10:10a	9.05	Purged 3/1
	11:00a	9.18	After sampling, Round 1
4/11	7:30a	8.98	After bailing 9 gallons
	1:15p	9.09	After sampling, Round 2
6/21	12:50p	8.91	Before bailing
6/22	9:33a	8.82	Before sampling, Round 3

Monitoring Well MW-104

Date	Time	pH	Comments
2/16	2:30p	11.66	Initial pH
	3:00p	10.51	After bailing dry (7 gallons)
	3:15p	10.35	After bailing dry
	3:35p	10.25	After bailing dry
2/20	3:20p	9.52	After bailing 2 gallons
	3:40p	9.36	After bailing dry (4.5 gallons)
	3:55p	9.15	After bailing dry
3/9	8:10a	8.91	Bailed 6 gallons 3/8 p.m., before sampling
	10:00a	8.90	After sampling, Round 1
4/11	2:20p	8.28	After bailing 6-7 gallons
4/12	10:45a	8.44	Before sampling
	1:00p	8.53	After sampling, Round 2
6/20	9:05a	8.21	Before sampling
	9:20a	8.45	After sampling, Round 3

Monitoring Well MW-105

Date	Time	pH	Comments
2/15	8:00a	10.25	Initial pH
	8:45a	10.45	After bailing 5 gallons
	9:00a	11.17	After bailing dry
	9:15a	11.46	After bailing 1 quart
2/17	1:30p	10.20	Initial pH
	1:45p	10.15	After bailing 2 gallons
	2:00p	10.36	After bailing 4 gallons
2/20	1:30p	10.25	Initial pH
	1:45p	10.26	After bailing 2.5 gallons
	2:00p	10.35	After bailing dry (5 gallons)
3/7	2:05p	9.83	Before sampling
	2:50p	11.23	After sampling, Round 1
3/29	9:50a	9.15	Bailed dry 3/27 a.m.
3/31	10:20a	9.01	Bailed dry 3/29 a.m.
4/6	7:55a	8.81	Initial pH
	8:15a	7.65	After bailing 5 gallons
	3:15p	8.43	After sampling, Round 2
6/16	8:30a	9.10	Before bailing
	9:00a	5.18	After bailing
6/21	9:05a	8.83	After bailing
6/22	12:15p	8.34	Before sampling, Round 3

Monitoring Well MW-106

Date	Time	pH	Comments
2/15	11:00a	10.12	Initial pH
	11:15a	9.54	After bailing dry
	11:30a	8.36	After bailing dry
	11:45a	7.65	After bailing dry
2/20	2:15p	8.12	Initial pH
	2:30p	7.25	After bailing dry (1.5 gallons)
3/7	12:00p	8.43	Before sampling, Round 1
4/5	3:25p	6.79	After bailing 2.5 gallons
4/6	9:45a	6.88	Before sampling
	10:30a	6.80	After sampling, Round 2
6/10	10:04a	6.12	After bailing
6/19	4:25p	7.05	After bailing
6/20	7:30a	6.91	Before sampling, Round 3

Monitoring Well MW-107

Date	Time	pH	Comments
2/15	2:30p	10.85	Initial pH
	2:55p	10.77	After bailing 6 gallons
	3:10p	11.56	After bailing dry
	3:25p	11.60	After bailing dry
2/20	2:45p	10.65	Initial pH
	3:10p	11.55	After bailing dry (0.5 gallon)
3/9	11:15a	–	After sampling, Round 1, no water
4/8	8:00a	9.58	After bailing 1 quart
4/10	3:30p	10.78	After bailing 0.5 pint
4/11	2:00p	–	Not enough water, no samples, Round 2
6/19	4:00p	9.02	After bailing
6/20	12:00p	8.38	Before sampling, Round 3

Monitoring Well MW-108

Date	Time	pH	Comments
2/16	8:50a	11.12	Initial pH
	9:25a	11.50	After bailing dry (5 gallons)
	9:40a	11.50	After bailing dry
	9:55a	11.07	After bailing dry
2/20	4:00p	11.56	Initial pH
	4:30p	10.83	After bailing dry
	4:50p	10.51	After bailing dry
3/7	7:20a	9.50	Bailed 6 gallons 3/6 p.m., before sampling
	8:00a	9.78	After sampling, Round 1
3/29	10:30a	8.98	Before bailing
3/31	11:10a	9.09	Before bailing
4/11	1:25p	8.92	After bailing 5 gallons
4/12	7:30a	8.60	Before sampling
	7:55a	8.56	After sampling, Round 2
6/21	2:10p	9.08	After bailing
6/22	8:31a	9.09	Before sampling, Round 3

Monitoring Well MW-109

Date	Time	pH	Comments
2/16	10:30a	10.95	Initial pH
	11:00a	10.85	After bailing dry
	11:15a	11.50	After bailing dry
	11:30a	10.87	After bailing dry
	11:50a	10.47	After bailing dry
2/28	3:00p	12.14	After bailing
3/1	9:55a	12.05	After sampling, Round 1
3/9	1.45p	–	Not enough water for pH
3/29	11:30a	9.50	Bailed dry 3/27 p.m.
3/31	11:50a	11.20	After bailing
3/31	1:40p	12.08	After bailing
4/8	7:30a	9.02	After bailing 1 quart
4/10	3:00p	9.26	After bailing 1.5 gallons
4/11	3:20p	9.64	After bailing 0.5 pint
4/12	10:40p	11.12	After sampling, Round 2
6/20	1:38p	8.91	Before bailing
6/21	8:05a	9.38	Before sampling, Round 3
6/22	1:07p	10.82	After sampling, Round 3

Monitoring Well MW-110

Date	Time	pH	Comments
2/17	8:00a	11.96	Initial pH
	8:15a	11.74	After bailing dry (3 gallons)
	8:35a	11.61	After bailing dry
	8:50a	11.31	After bailing dry
2/24	2:55p	6.14	After bailing
	3:35p	6.59	After sampling, Round 1
4/5	9:00a	11.15	Initial pH, bailed 3 gallons to dry
	9:15a	11.03	After bailing
	2:00p	6.64	Before sampling
	3:00p	7.49	After sampling, Round 2
6/15	12:00p	7.0	Before sampling
	12:00p	7.1	After sampling, Round 3

Monitoring Well MW-111

Date	Time	pH	Comments
2/17	10:30a	11.75	Initial pH
	10:50a	11.57	After bailing dry
	11:10a	11.73	After bailing dry
	11:30a	11.91	After bailing dry
3/2	2:55p	6.49	Purged 3/2 a.m.
	4:16p	4.90	After sampling, Round 1
4/11	8:15a	9.07	After bailing dry
	12:30p	9.11	After sampling, Round 2
6/21	10:20a	8.76	After bailing
6/22	11:07a	8.74	Before sampling, Round 3

Monitoring Well MW-201

Date	Time	pH	Comments
2/21	4:30p	6.08	Initial pH
	5:00p	6.31	After bailing 3 gallons
3/7	10:30a	6.6	Bailed 3/6 p.m., after sampling, Round 1
4/10	9:30a	6.5	After bailing 3.5 gallons
	2:15p	6.57	After sampling, Round 2
6/19	2:10p	6.55	After bailing
6/20	9:55a	6.67	Before sampling, Round 3

Monitoring Well MW-202

Date	Time	pH	Comments
2/21	10:50a	6.06	Initial pH
	11:30	6.32	After bailing dry
2/24	9:40a	6.35	After bailing
	11:25a	6.39	After sampling, Round 1
4/5	10:17a	6.87	Initial, before purging
	10:30a	6.41	Before sampling
	1:00p	6.38	After sampling, Round 2
6/15	9:30a	6.40	Before bailing 8 gallons
	10:45a	6.40	After sampling, Round 3

Monitoring Well MW-203

Date	Time	pH	Comments
2/21	3:15p	6.22	Initial pH
	3:30p	6.32	After bailing dry
3/1	2:46p	6.48	After bailing
	3:20p	7.02	After sampling, Round 1
4/10	10:30a	6.56	After bailing dry (10 gallons)
	1:00p	6.54	After sampling, Round 2
6/21	11:50a	6.74	Before bailing 3 well volumes
	12:10p	6.66	Before sampling, Round 3

Monitoring Well MW-204

Date	Time	pH	Comments
2/16	3:55p	6.44	Initial pH
	4:15p	6.45	After bailing dry
	4:30p	6.50	After bailing dry
2/22	10:15a	5.96	Before bailing
3/9	11:00a	–	Not enough water for pH, Round 1
4/11	3:00p	6.75	After bailing 1 quart
4/12	11:30a	6.72	After sampling, Round 2
6/20	8:00a	6.60	Before sampling, Round 3

Monitoring Well MW-205

Date	Time	pH	Comments
2/15	9:45a	5.9	Initial pH
	10:15a	6.15	After bailing dry (3 gallons)
	10:30a	6.23	After bailing
2/22	8:00a	5.85	Before bailing
	8:45a	6.04	After bailing 2.5 gallons
3/7	3:35p	5.25	After sampling, Round 1
4/6	8:45a	6.41	Initial pH
	9:00a	5.73	After bailing 2 gallons
	1:17p	5.32	Before sampling
	1:50p	5.65	After sampling, Round 2
6/16	9:20a	7.10	After bailing
	1:15p	4.45	Before sampling
	1:15p	4.70	After sampling, Round 3

Monitoring Well MW-206

Date	Time	pH	Comments
2/15	1:00p	6.12	Initial pH
	1:45p	6.37	After bailing dry
	2:00p	6.35	After bailing dry
	2:15p	6.13	After bailing dry
2/22	9:00a	6.11	Initial pH
	9:20a	6.10	After bailing 2 gallons
3/7	2:00p	5.90	Bailed 3/6 p.m., after sampling, Round 1
4/5	3:41p	6.08	After bailing
4/6	9:15a	6.24	Before sampling
	9:40a	5.98	After sampling, Round 2
6/16	10:27a	6.16	After bailing
	12:00p	5.90	Before sampling
	12:00p	5.80	After sampling, Round 3

Monitoring Well MW-207

Date	Time	pH	Comments
2/15	3:30p	6.45	Initial pH
	4:00p	6.56	After bailing dry
	4:15p	6.56	After bailing dry
	4:45p	6.47	After bailing dry
2/22	9:45a	6.07	After bailing dry
3/9	1:15p	6.4	Bailed 3/8 p.m., after sampling, Round 1
4/11	2:10p	6.31	After bailing 1.5 gallons to dry
4/12	9:55a	6.56	After sampling, Round 2
6/19	4:15p	6.26	After bailing
6/20	12:45p	6.04	Before sampling
	1:05p	6.19	After sampling, Round 3

Monitoring Well MW-208

Date	Time	pH	Comments
6/16	10:20a	–	Dry
4/11	1:50p	6.64	After bailing 1 pint to 1 quart
4/12	8:55a	6.74	After sampling, Round 2
6/21	2:45p	6.43	After bailing
6/22	9:10a	6.64	Before sampling, Round 3

Monitoring Well MW-209

Date	Time	pH	Comments
2/16	1:00p	5.61	Initial pH
	2:00p	5.90	After bailing dry
	2:20p	5.96	After bailing dry
2/22	10:45a	6.27	After bailing dry
3/9	2:15p	5.95	Bailed 3/8, after sampling, Round 1
4/10	3:20p	6.12	After bailing 1 gallon
4/11	9:30a	5.96	After sampling, Round 2
6/20	2:15p	5.61	After bailing
6/21	7:15a	5.97	Before sampling, Round 3

Monitoring Well MW-210

Date	Time	pH	Comments
2/17	9:00a	6.21	Initial pH
	9:25a	6.16	After bailing dry (0.75 gallon)
	9:45a	6.15	After bailing dry
	10:05a	6.20	After bailing dry
2/22	12:45p	6.05	Before bailing
	1:30p	6.27	After bailing dry (1 gallon)
2/28	1:30p	6.19	After purging, before sampling
3/1	9:05a	6.19	Before sampling
	9:50a	6.30	After sampling, Round 1
4/5	3:10p	6.16	After bailing 2 gallons
4/6	10:33a	5.96	Before sampling
	11:15a	6.11	After sampling, Round 2
6/15	12:35p	5.9	Before sampling
	12:35p	6.1	After sampling, Round 3

Monitoring Well MW-211

Date	Time	pH	Comments
2/21	1:00p	6.08	Initial pH
	1:15p	6.36	After bailing 4 gallons
	1:30p	6.21	After bailing dry
2/22	1:45p	6.23	Before bailing
	2:15p	6.20	After bailing 3 gallons
3/3	11:00a	5.17	After bailing 3/2
	11:50a	5.09	After sampling, Round 1
4/11	8:40a	6.67	Before sampling
	10:15a	6.57	After sampling, Round 2
6/21	9:50a	6.76	After bailing
6/22	10:30a	6.82	Before sampling, Round 3

APPENDIX D - TEST PIT LOGS

Doc. No. DL-No. 13

Drilling Log

Project Name		Boring No.
ROSECHEM		TP-1
Project No.		**Page** 1 of 1
88-025-4		
Ground Elevation	**Location**	**Total Footage**
		3' 0"

Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
BACKHOE		2' 0"	1' 0"	1	N/A	SEE REMARKS	

Drilling Co. LAYNE WESTERN	**Driller (s)** TOM BUTLER, RUSTY BOWLES
Drilling Rig. BACKHOE	**Type of Penetration Test**
Date 1/13/89 **To** 1/13/89	**Field Observer (s)** G. NIEMAN, D. BALLARD

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
1	Dark brown silty clay, damp to moist, medium to highly plastic						START 3:12 p
2	Gray, microcrystalline limestone, strong, crinoids.						Top of clay rock 2.0' Slightly weathered at top.
3	Total Depth 3'0"						Invert elev. at 3.0'
4							Dry at completion
							Finish 4:30 p.
5							
6							
7							
8							
9							
10							
11							
12							
13							

Doc No. DL-No. 14

Drilling Log

Project Name						Boring No.	
ROSECHEM						TEST PIT # 2	
Project No.						Page 1 of 1	
88-025-4							
Ground Elevation		Location				Total Footage 6' 0"	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
BACKHOE		6' 0"	0' 0"	1	N/A	SEE REMARKS	
Drilling Co. LAYNE WESTERN						Driller (s) TOM BUTLER, RUSTY BOWLES	
Drilling Rig. BACKHOE						Type of Penetration Test	
Date 1/16/89		To 1/16/89				Field Observer (s) GREG NIEMAN, D. BALLARD	

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
	Dark brown clay, dry to damp, low plasticity, organic debris.						Start 9:53a.
	Gravel fill material						
1	Brown clay, slightly silty, damp, low to medium plasticity.						Possible fill material.
2	Gravel fill material						Clay pipe invert at 2.5' Top 2.1'
	Brown clay, damp, low plasticity						
3							Possible fill material
4	Gravel fill material						
	Brown clay grading into Brown-orange mottled, damp, medium plasticity						
5							
6	Total Depth 6' 0"						
							Dry at completion
7							Finish 10:15 a.
8							
9							
10							
11							
12							
13							

Doc. No. DL-No. 15

Drilling Log

Project Name						Boring No.	
ROSECHEM						TP-3	
Project No.						Page	of
88-025-4						1	1
Ground Elevation		Location				Total Footage	
						4' 0"	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
BACK HOE		4'0"	0' 0"	1	N/A	SEE REMARKS	

Drilling Co.	LAYNE WESTERN	Driller (s)	TOM BUTLER, RUSTY BOWLES
Drilling Rig.	BACKHOE	Type of Penetration Test	
Date	1/16/89 To 1/16/89	Field Observer (s)	G. NIEMAN, D. BALLARD

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
1	Brown-orange mottled clay, damp, medium plasticity						Start 10:37a.
2							-Top of pipe 1'8"
3							Invert 3'6"
4	Brown-orange mottled clay, damp, medium plasticity, some granular fill.						
	Total Depth 4'0"						Finish 11:03a.
5							2" standing water at time of completion.
6							
7							
8							
9							
10							
11							
12							
13							

Doc. No. DL-No. 16

Drilling Log

Project Name: ROSECHEM						Boring No.: TP-4	
Project No.: 88-025-4						Page: 1 of 1	
Ground Elevation		Location				Total Footage: 3' 6"	
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water	Date Measured
BACKHOE		3' 6"	0' 0"	1	N/A	SEE REMARKS	

Drilling Co.: LAYNE WESTERN — Driller (s): TOM BUTLER, RUSTY BOWLES

Drilling Rig.: BACKHOE — Type of Penetration Test:

Date: 1/16/89 To 1/16/89 — Field Observer (s): G. NIEMAN, D. BALLARD

Depth	Description	Class.	Blow Count	Recov.		Sample or Box No.	Remarks
1	Brown-oranae mottled clay, moist, medium plastic, trace organics debris						Start 11:15a.
2							Top of pipe 1' 4"
3							Invert elev. 3' 6"
4	Total Depth 3' 6"						Dry at completion Finish 11:45a
5							
6							
7							
8							
9							
10							
11							
12							
13							

Doc No. DL.-No 17

Drilling Log

Project Name						Boring No.
ROSECHEM						TP-5
Project No.						Page 1 of 1
88-025-4						
Ground Elevation		Location				Total Footage 6' 6"
Drilling Type	Hole Size	Overburden Footage	Bedrock Footage	No. of Samples	No. Core Boxes	Depth To Water / Date Measured
BACKHOE		6'6"	0' 0"	1	N/A	SEE REMARKS
Drilling Co. LAYNE WESTERN					Driller (s) TOM BUTLER, RUSTY BOWLES	
Drilling Rig. BACKHOE					Type of Penetration Test	
Date 1/16/89	To 1/16/89				Field Observer (s) G. NIEMAN, D. BALLARD	

Depth	Description	Class.	Blow Count	Recov.	Sample or Box No.	Remarks
1	Brown-orange mottled clay, damp, medium plasticity, trace of organic debris and some iron staining.					Start 1:43 a.
2						
3						
4						
5						Top of pipe 5'0"
6						Invert elev. 6'0" granular backfill to 6'4"
7	Total Depth 6'6"					Water running through granular backfill at completion.
8						Finish. 2:16 a.
9						
10						
11						
12						
13						

APPENDIX E - ANALYTICAL LABORATORY RESULTS - KANSAS CITY TESTING

KANSAS CITY TESTING LABORATORY

SUMMARY OF SOIL TESTS

PROJECT ROSECHEM PROJECT NO 409-J-078

*small sample size
**insufficient material

BORING NUMBER	SAMPLE NUMBER	DEPTH ft	% MOISTURE	DRY UNIT WT.-PCF	UNCONFINED COMPRESSION		ATTERBERG LIMITS			% -200	UNIFIED CLASSIFICATION					REMARKS
					PSF	%E	LL	PL	PI							
SED 21		SURFACE	35.7							17.7*	**					
SED 29		SURFACE	57.5				48	24	24	81.7	CL					
SED 31		SURFACE	42.2				49	24	25	91.6	CL					
SED 32		SURFACE	59.9				55	23	32	56.9	CH					
MW 105	ST-1	6.0- 8.0	21.2	91.9												consolidation permeability
MW 105	SS-5	9.5-10.0	17.9				44*	22	22	**	CL					
MW 106	SS-6	11.5-13.5	28.8				77	25	52*	89.4	CH					
MW 106	ST-1	8.0- 9.5	23.8	99.7												consolidation permeability
MW 107	SS-4	8.0-10.0	34.3				61	28	33	95.6	CH					
MW 108	SS-3	4.0- 6.0	18.8				56	26	30	92.9	CH					
MW 110	ST-1	8.0-10.0	27.5	95.1												consolidation permeability
MW 110	SS-5	10.0-12.0	24.1				54	20	34	87.5	CH					
MW 111	SS-6	10.0-12.0	28.2				52	20	32	88.2	CH					
B-1	SS-3	5.0- 7.0	22.7				67	21	46	89.4	CH					
B-2	SS-3	5.0- 7.0	28.1				87	22	65	**	CH					
B-2	SS-4	7.0- 9.0	23.7				72	21	51	93.0	CH					
B-3	SS-1	0.8- 1.8	24.8				46	23	23	**	CH					
B-4	SS-5	8.5-10.2	21.1				53*	21	32	92.3	CH					
B-5	SS-6	10.0-11.3	19.5				46	21	25	**	CL					

KANSAS CITY TESTING LABORATORY

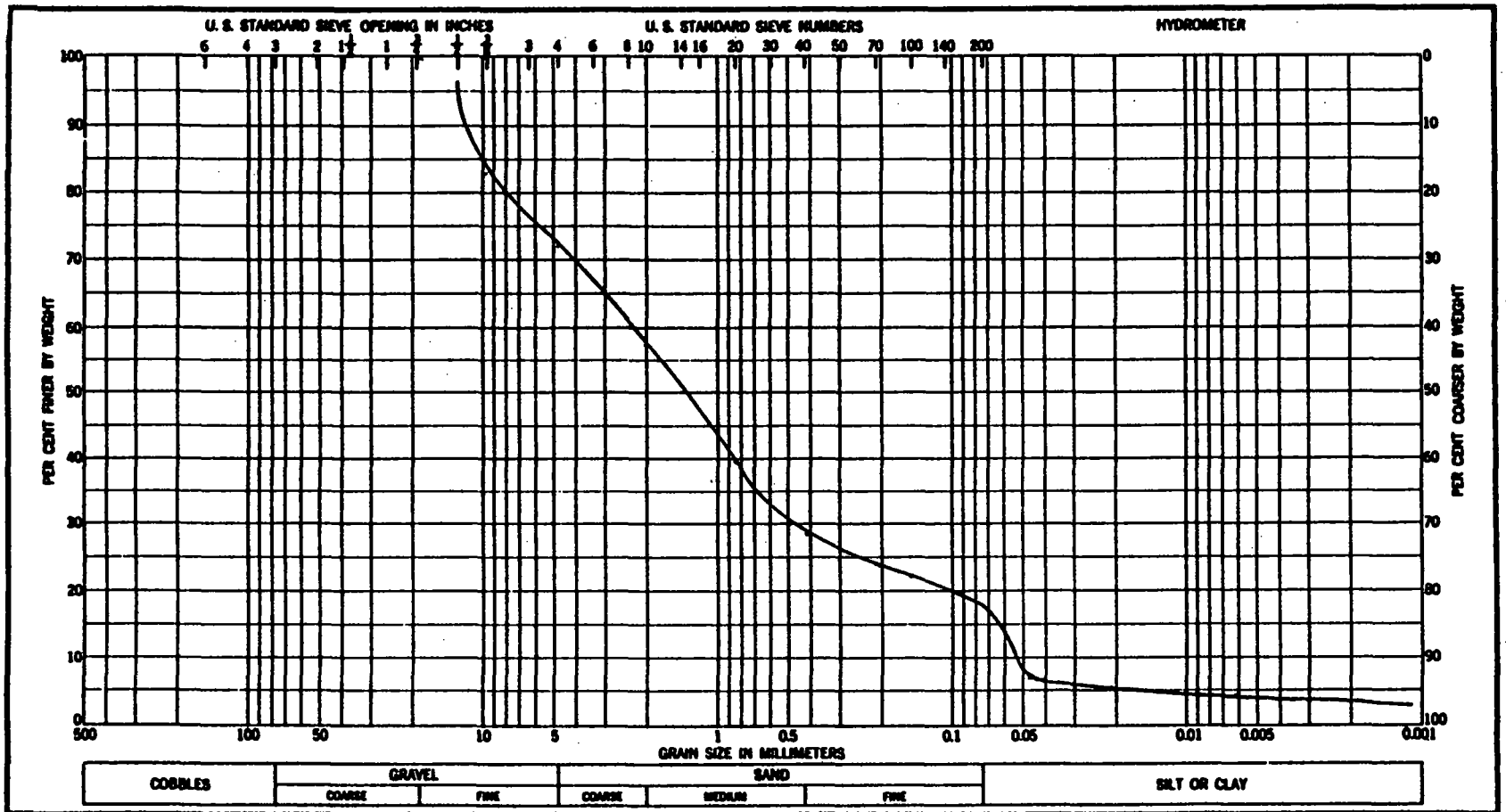
SUMMARY OF SOIL TESTS

PROJECT ROSECHEM PROJECT NO 409-J-078

BORING NUMBER	SAMPLE NUMBER	DEPTH ft	% MOISTURE	DRY UNIT WT.-PCF	UNCONFINED COMPRESSION		ATTERBERG LIMITS			% -200	UNIFIED CLASSIFICATION					REMARKS
					PSF	%E	LL	PL	PI							
B-6	SS-4	7.0- 9.0	24.9				55*	21*	34	86.9	CH					
B-7	SS-3	5.0- 7.0	23.4				61	19	42	95.6	CH					
B-7	SS-5	9.0-11.0	19.6				43	22	21	88.4	CL					
B-8	SS-5	9.0-11.0	21.0				50	20	30	**	CH					
B-8	SS-6	11.0-11.9	19.1				**			**						

*small sample size
**insufficient material

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SED 21	SURFACE		35.7			
		NOTE: Small sample size				

GRADATION CURVES

Project ROSECHEM

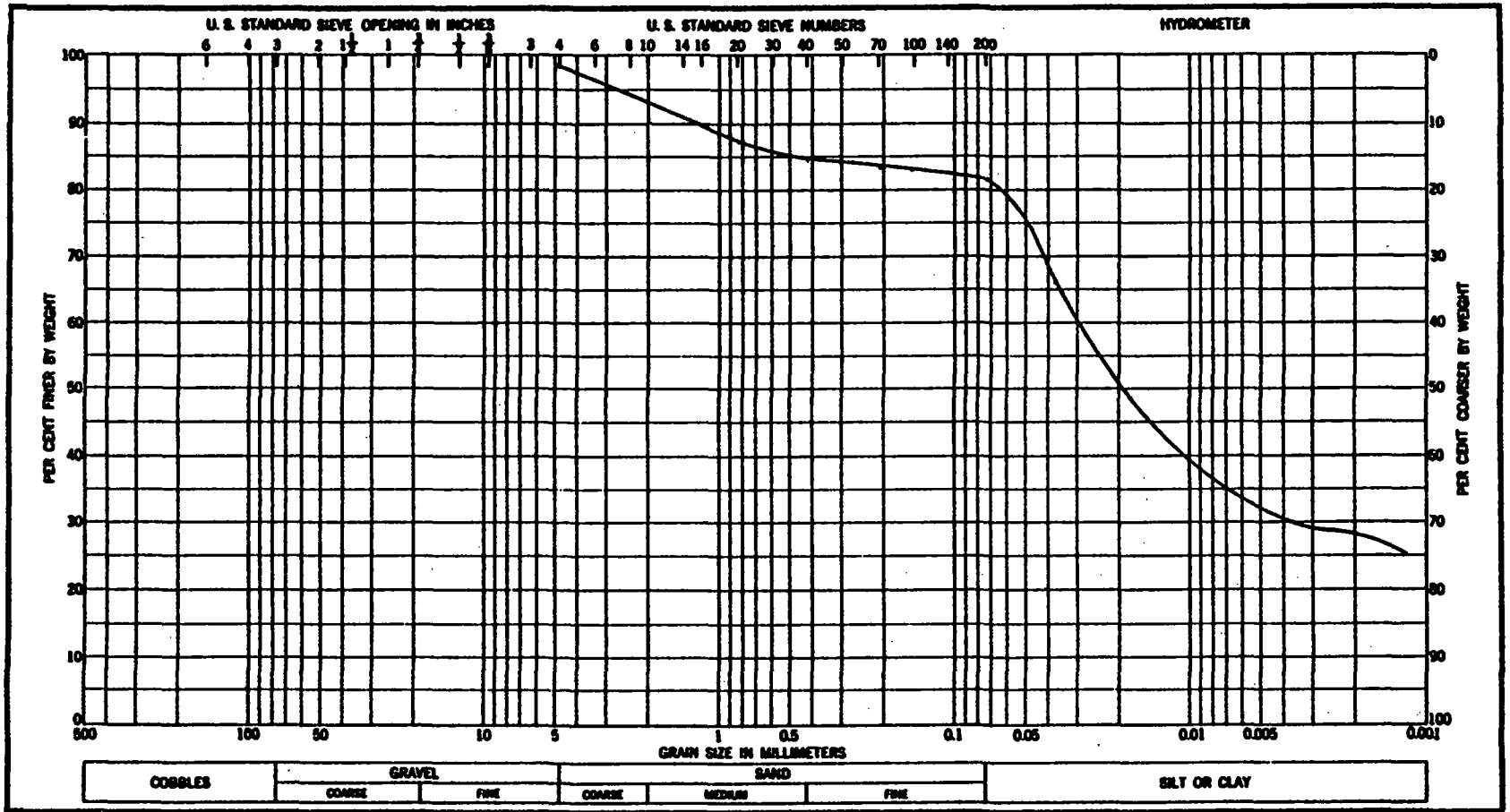
Job No. 409-J-078

Area

Boring No. SED 21

Date

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
	SURFACE	CL	57.5	48	24	24

GRADATION CURVES

Project ROSECHEM

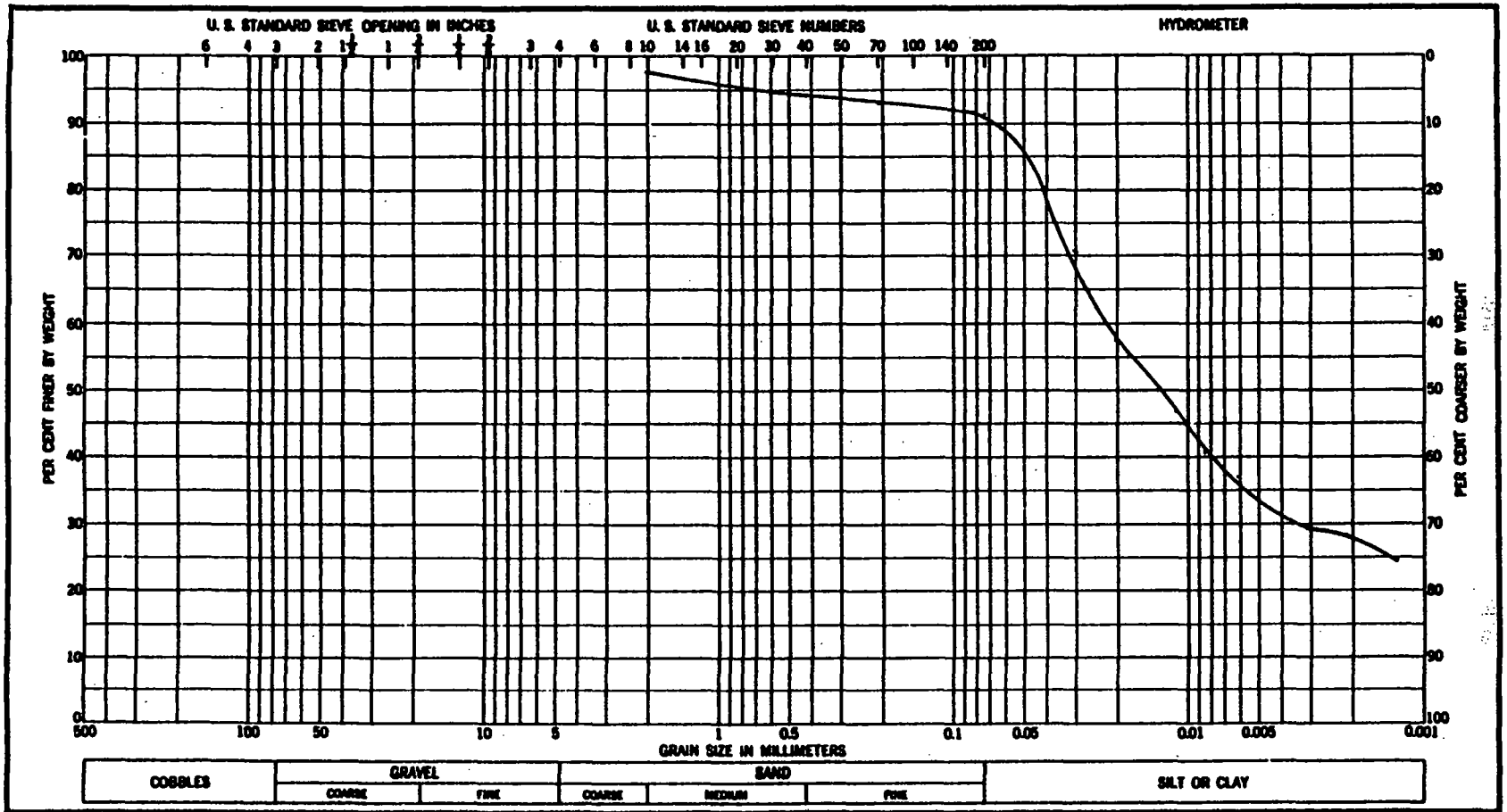
Job No. 409-.1-078

Area

Boring No. SED 29

Date

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
	SURFACE	CL	42.2	49	24	25

GRADATION CURVES

Project ROSECHEM

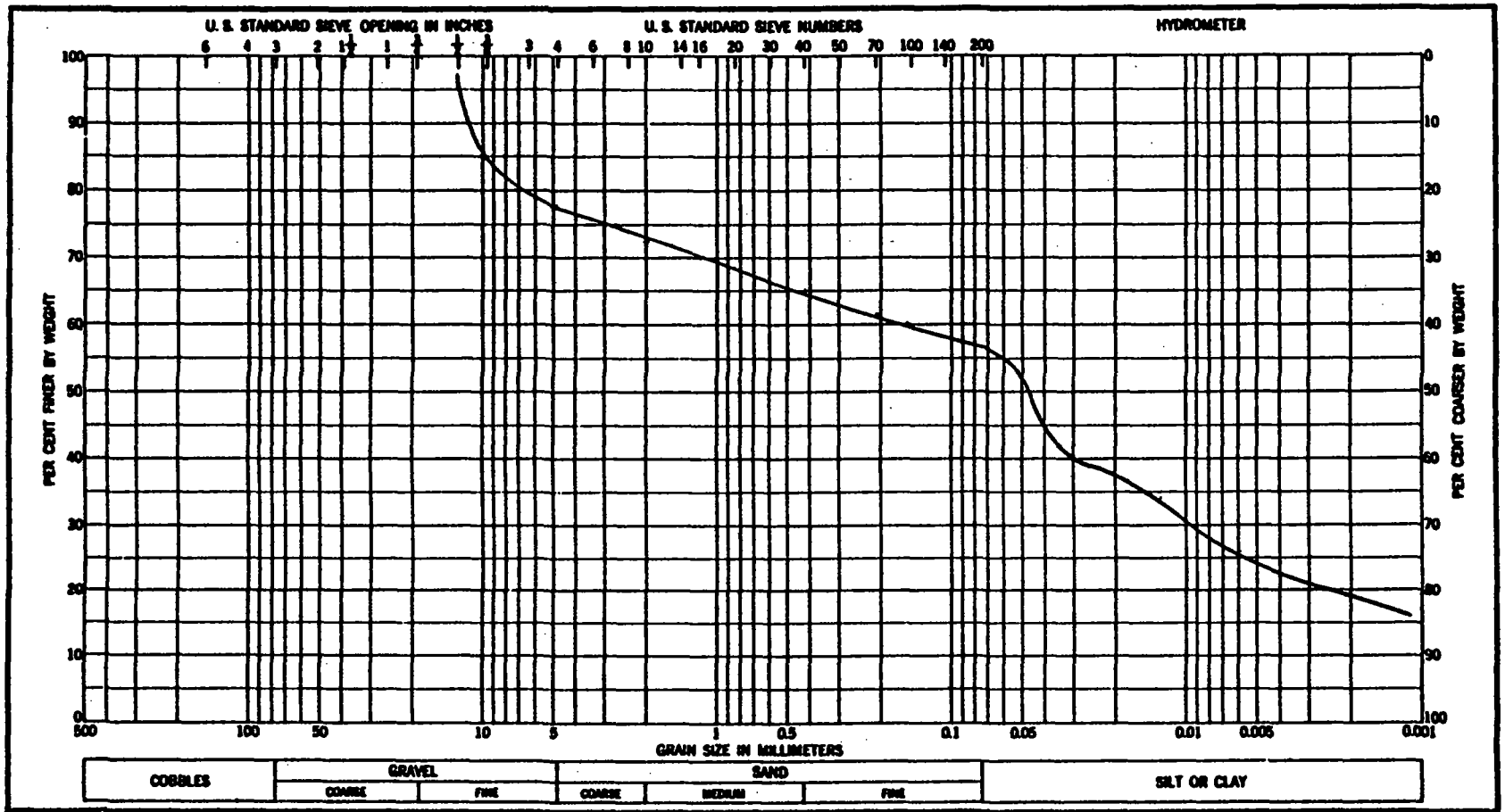
Job No. 409-J-078

Area

Boring No. SED 31

Date

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
	SURFACE	CH	59.9	55*	23	32
		*sample too small for duplicate trial				
		NOTE: Small sample size				

GRADATION CURVES

Project ROSECHEM

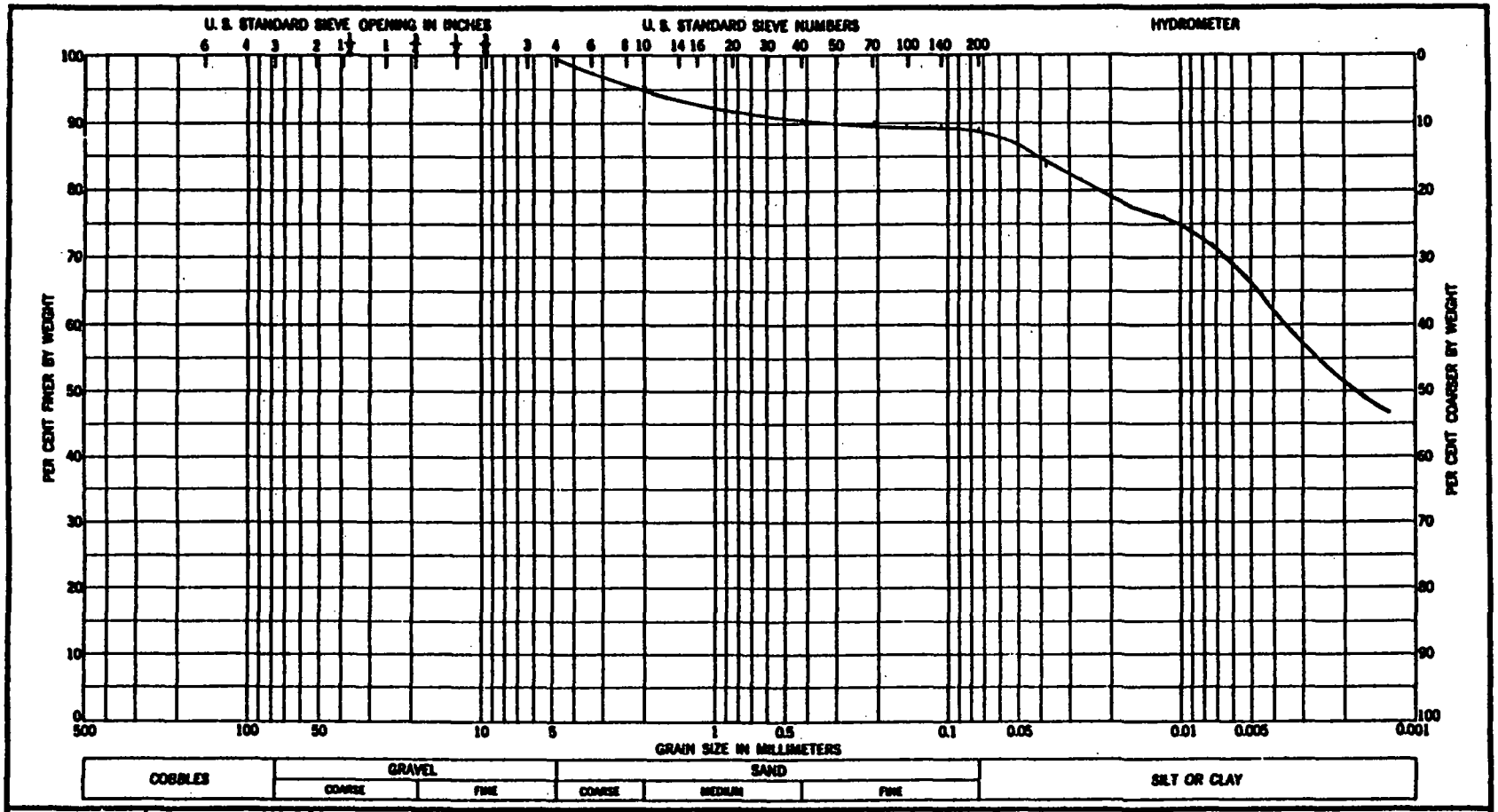
Job No. 409-J-078

Area

Boring No. SED32

Date

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS 6	11.5-13.5	CH	28.8	77	25*	52
		*sample too small for duplicate trial				

GRADATION CURVES

Project ROSECHEM

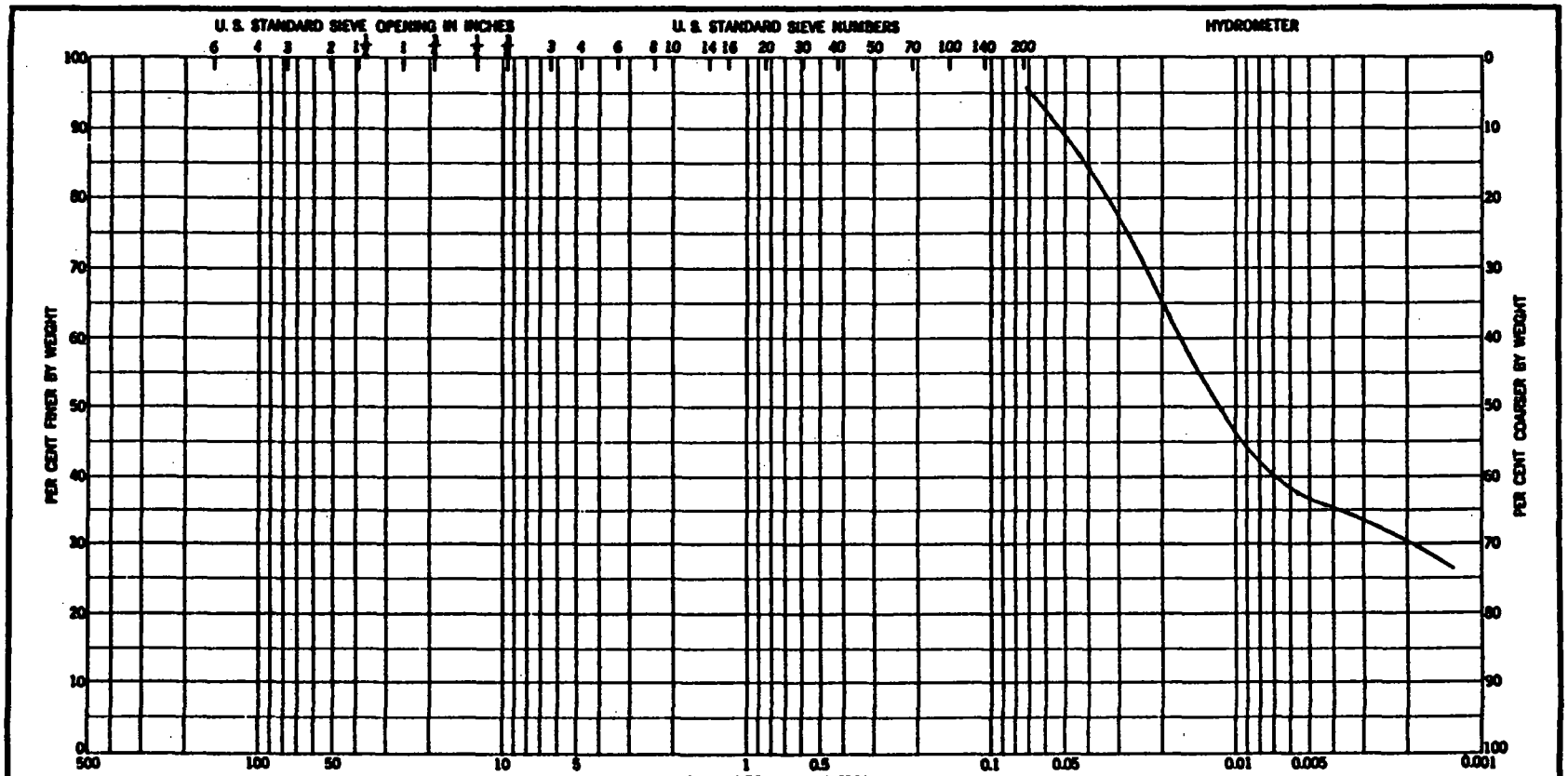
Job No. 409-I-078

Area

Boring No. MW106

Date

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS 4	8.0-10.0	CH	34.3	61	28	33

GRADATION CURVES

Project ROSECHEM

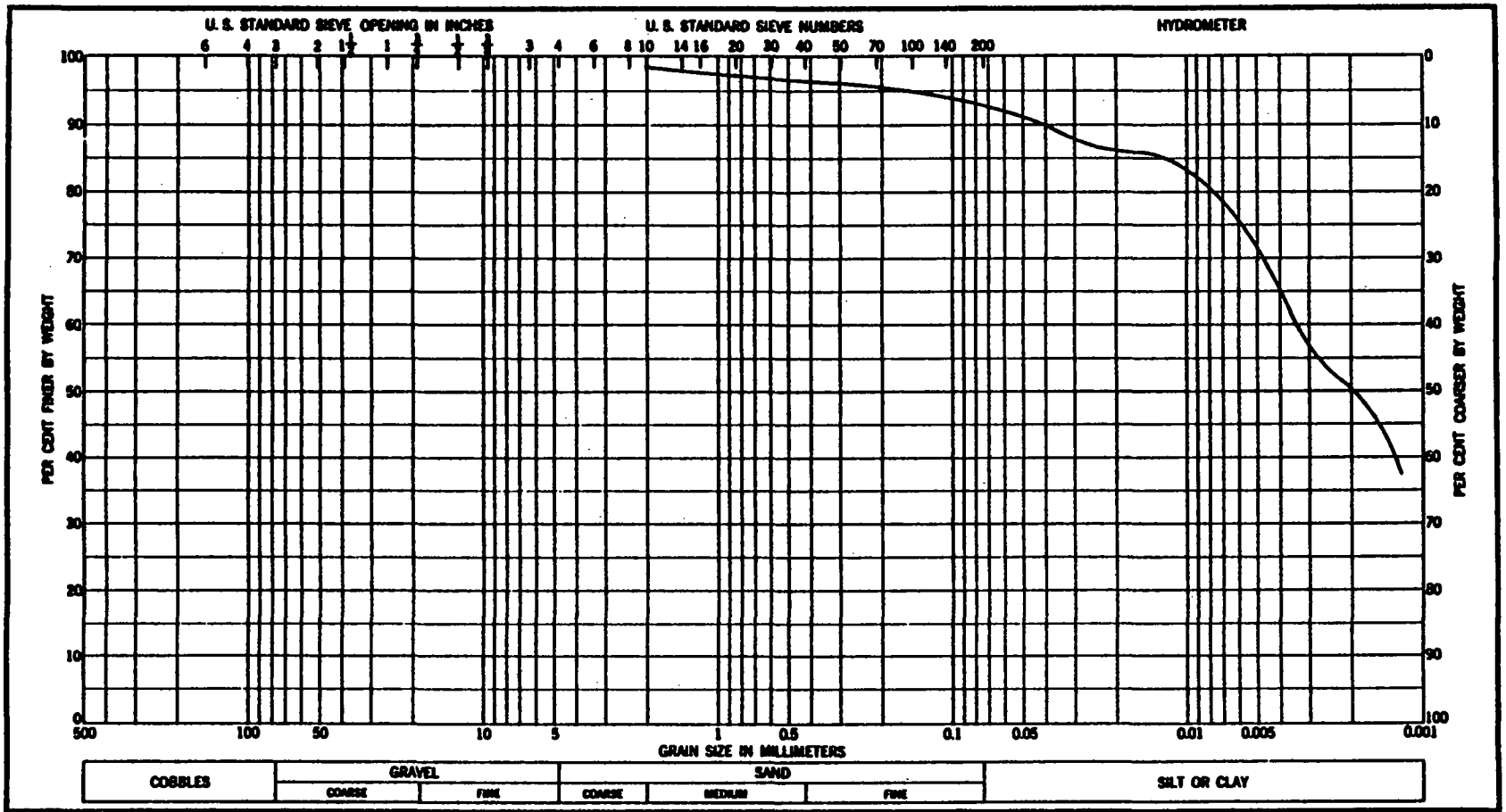
Job No. 409-J-078

Area

Boring No. MW107

Date

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS 3	4.0-6.0	CH	18.8	56	26	30

GRADATION CURVES

Project ROSECHEM

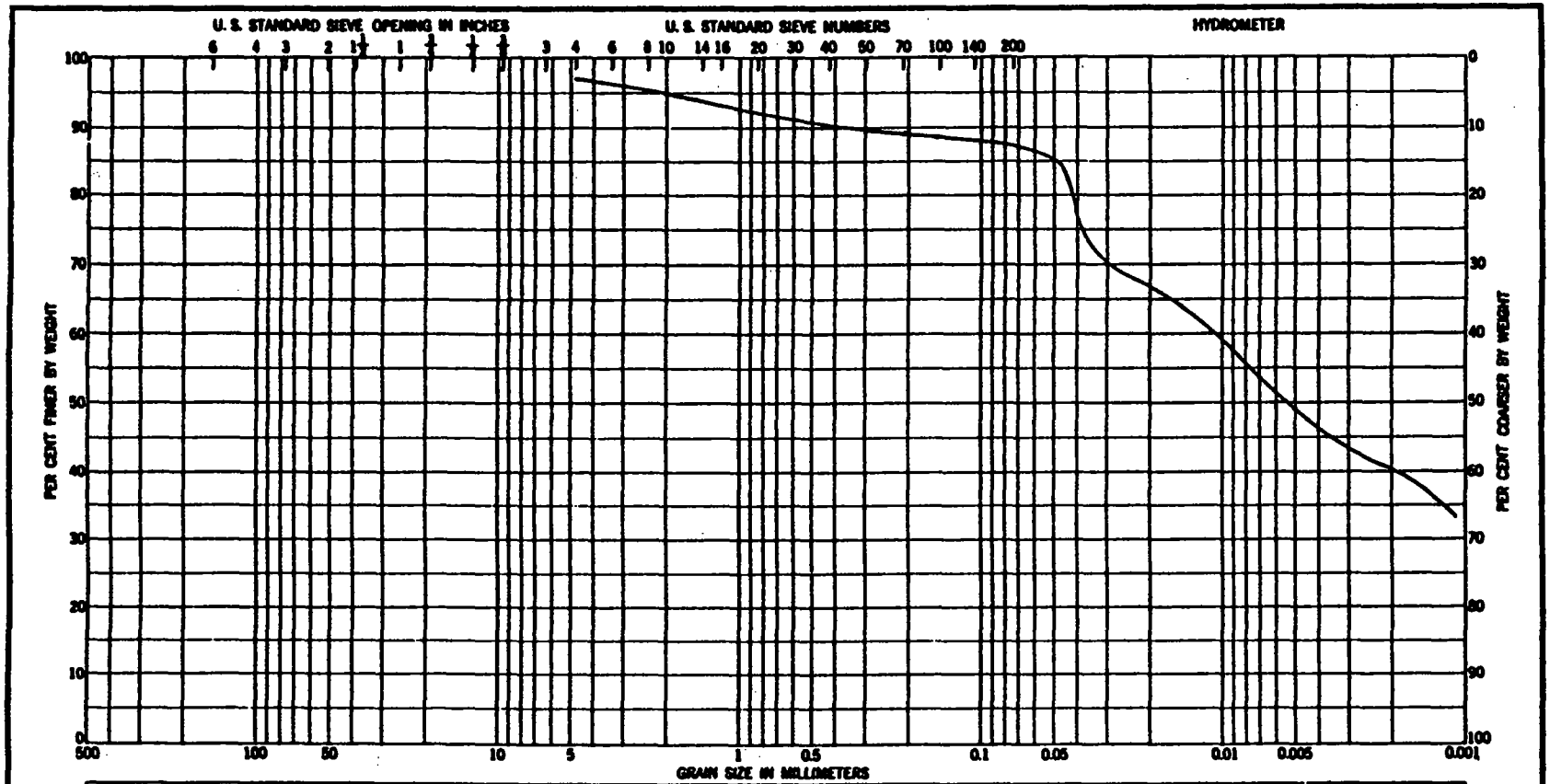
Job No. 409-J-078

Area

Boring No. MW 108

Date

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS 5	10.0-12.0	CH	24.1	54	20	34

GRADATION CURVES

Project ROSECHEM

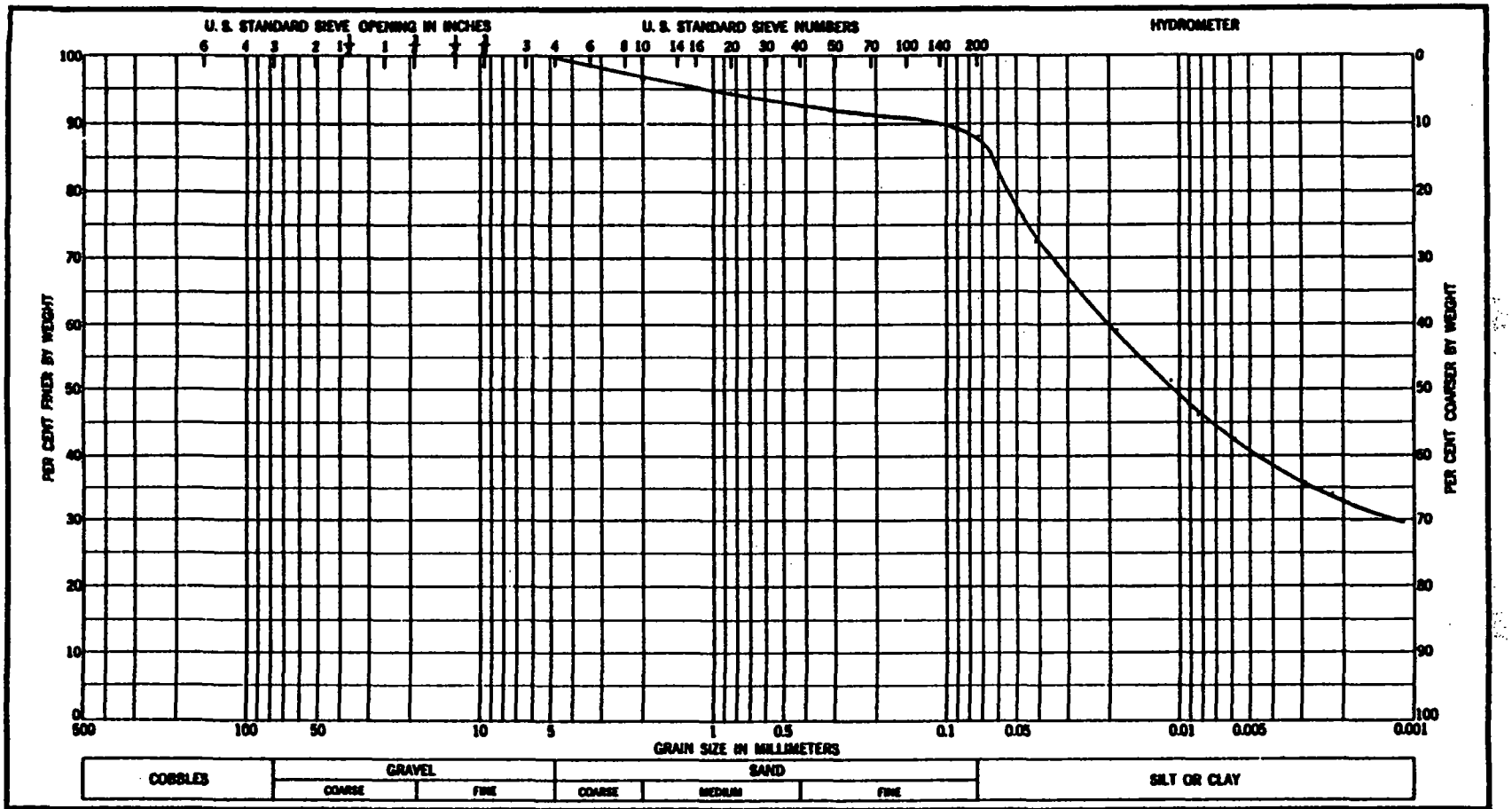
Job No. 409-J-078

Area

Boring No. MW 110

Date

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS 6	10.0-12.0	CH	28.2	52	20	32

GRADATION CURVES

Project ROSECHEM

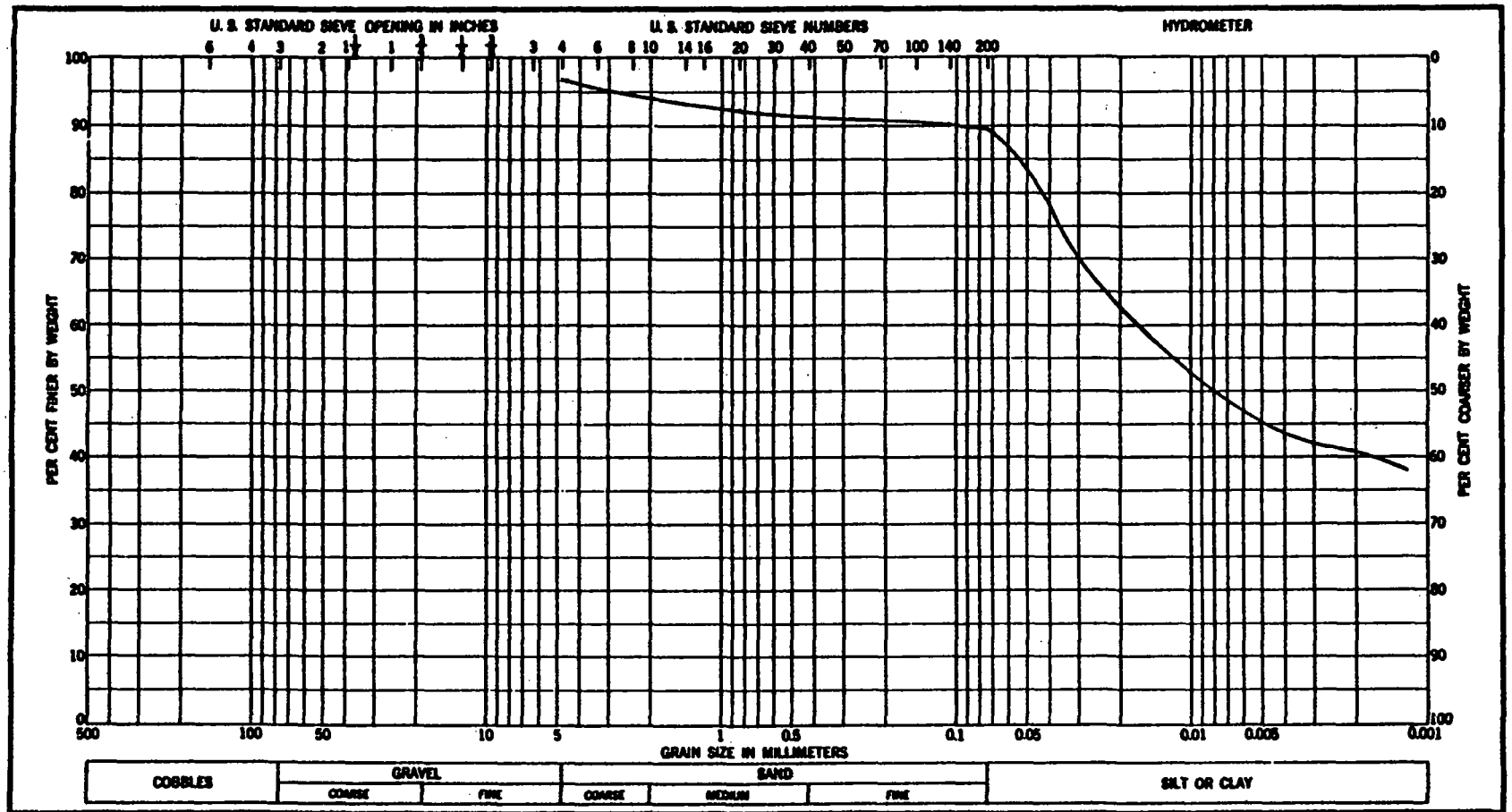
Job No. 409-J-078

Area

Boring No. MW 111

Date

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS 3	5.0-7.0	CH	22.7	67	21	46

GRADATION CURVES

Project ROSECHEM

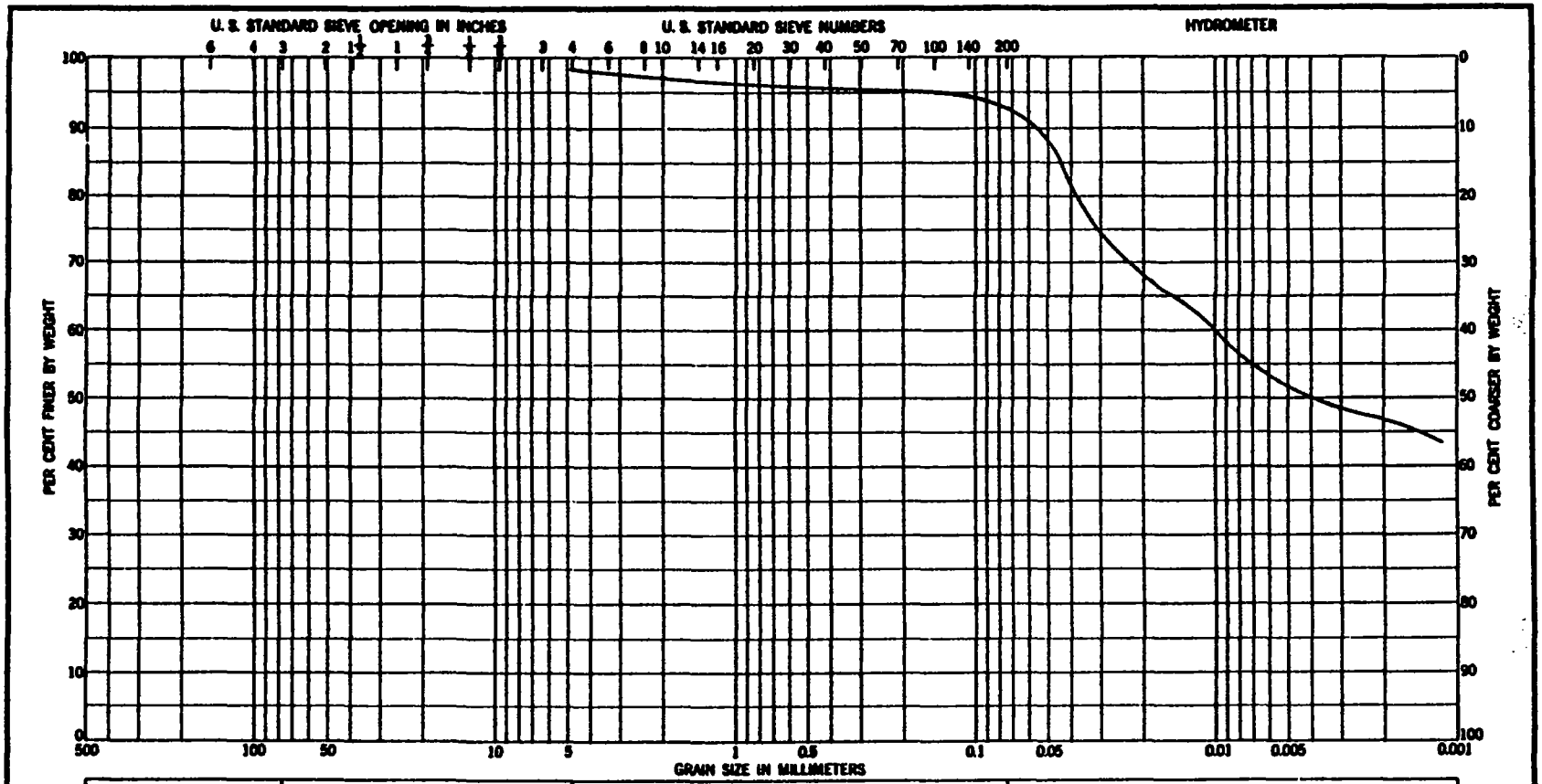
Job No. 409-J-078

Area

Boring No. 1

Date

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS 4	7.0-9.0	CH	23.7	72	21	51

GRADATION CURVES

Project ROSECHEM

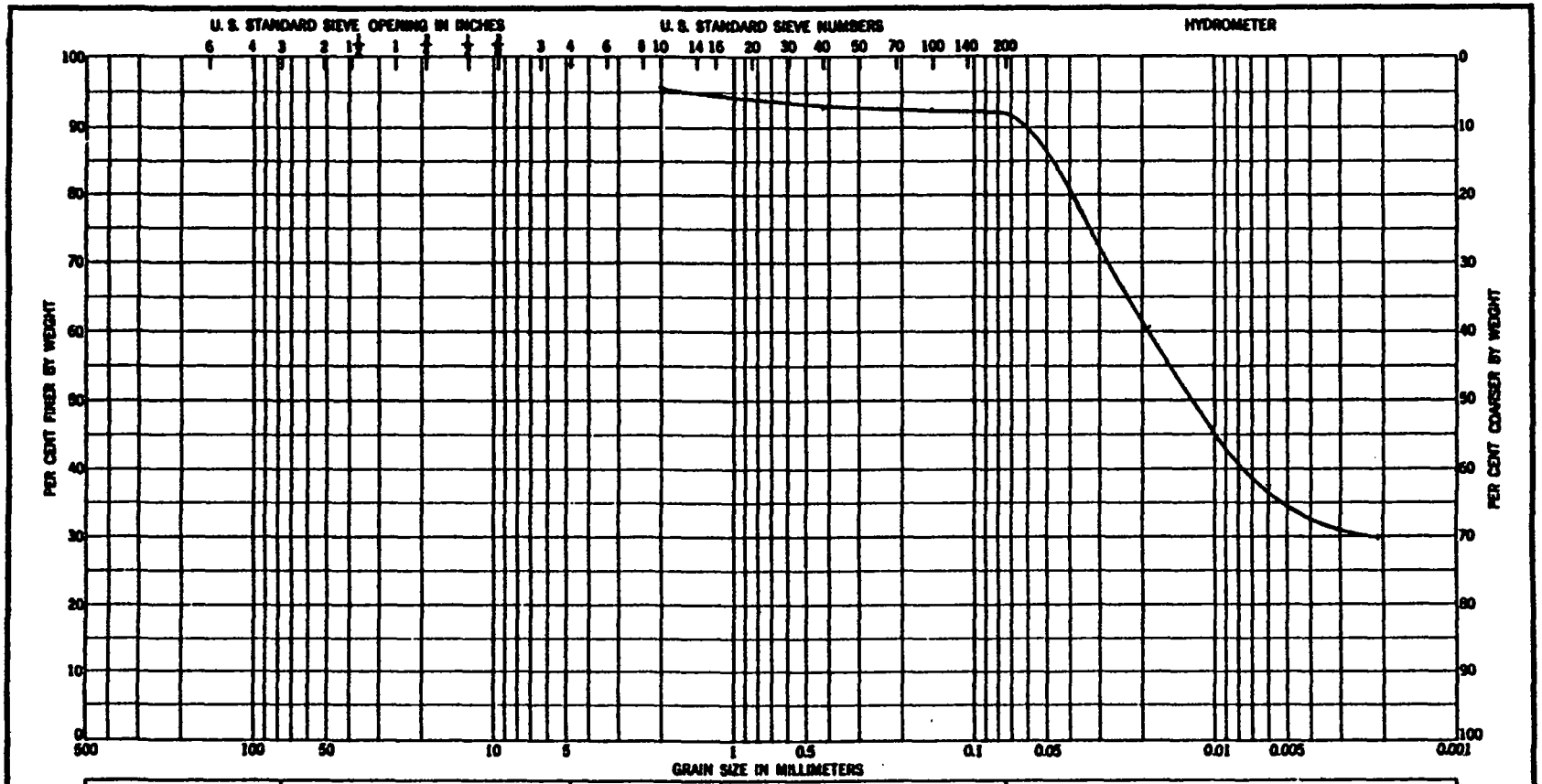
Job No. 409-J-078

Area

Boring No. 2

Date

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS 5	8.5-10.2	CH	21.1	53*	21	32
		*sample too small for duplicate trial				

GRADATION CURVES

Project ROSECHEM

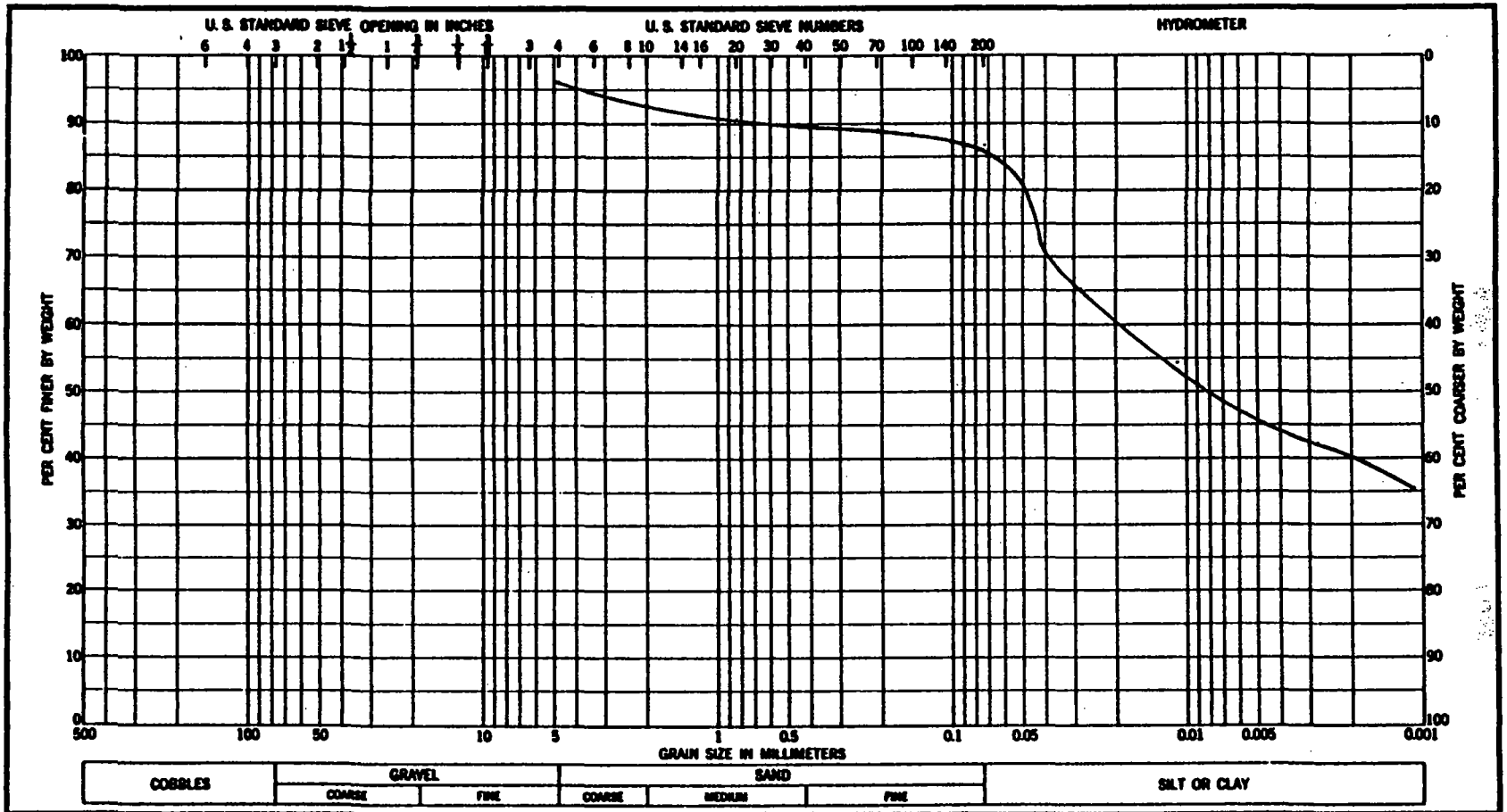
Job No. 409-J-078

Area

Boring No. 4

Date

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS 4	7.0-9.0	CH	24.9	55*	21*	34

*sample too small for duplicate trial

GRADATION CURVES

Project ROSECHEM

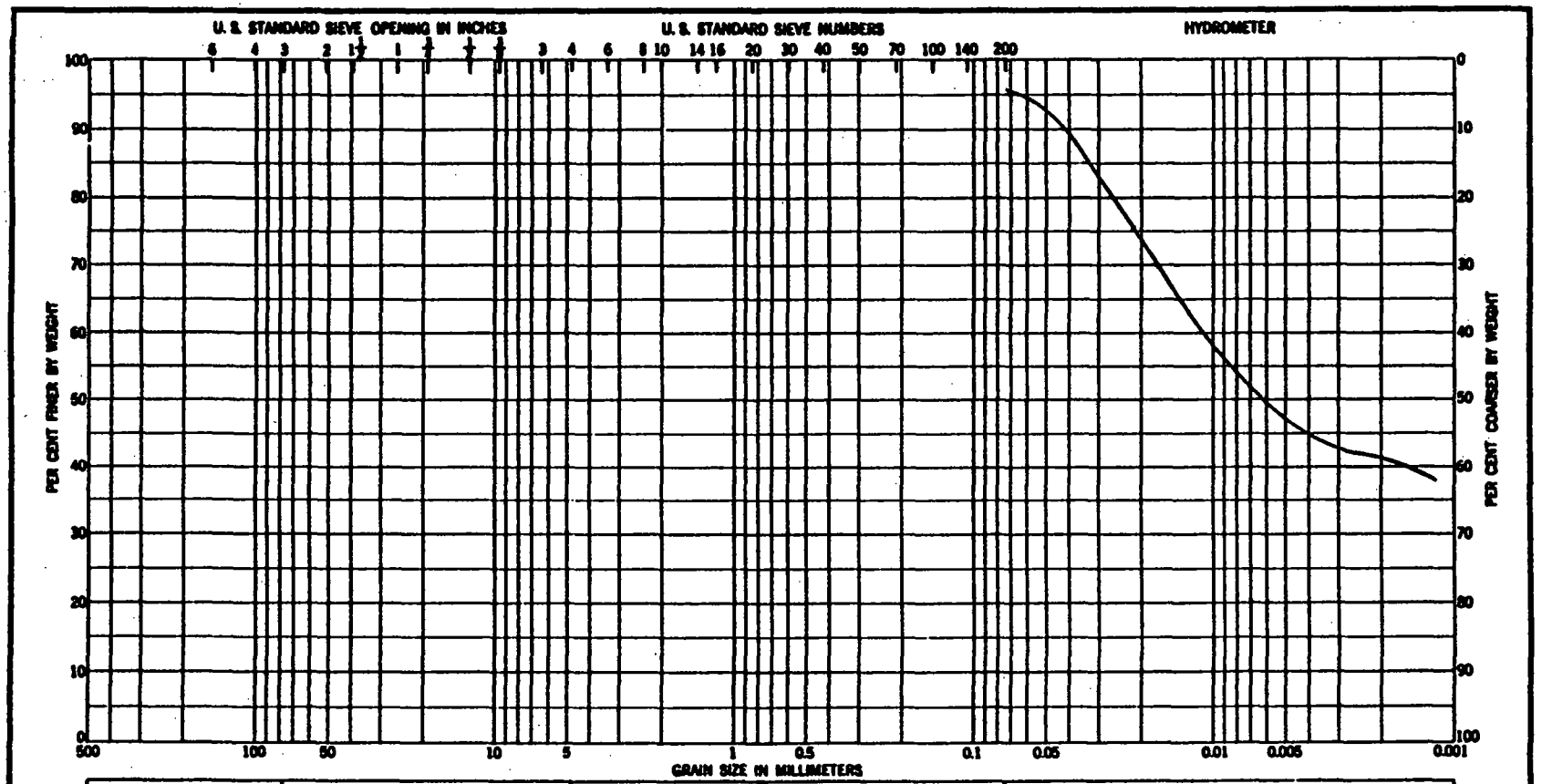
Job No. 409-J-078

Area

Boring No. 6

Date

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS 3	5.0-7.0	CH	23.4	61	19	42

GRADATION CURVES

Project ROSECHEM

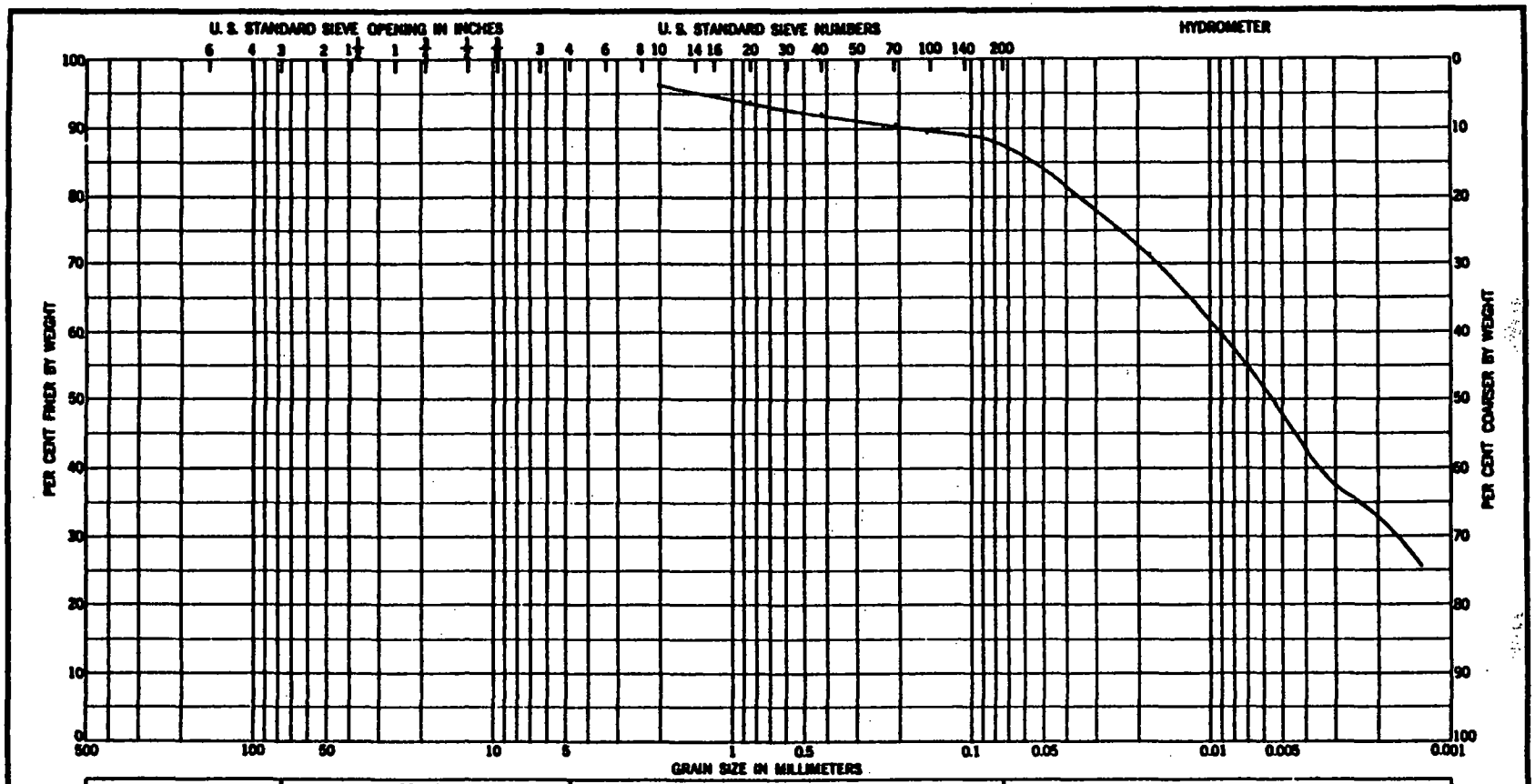
Job No. 409-J-078

Area

Boring No. 7

Date

KANSAS CITY TESTING LABORATORY



Sample No.	Elev or Depth	Classification	Nat w %	LL	PL	PI
SS 5	9.0-11.0	CL	19.6	43	22	21

GRADATION CURVES

Project ROSECHEM

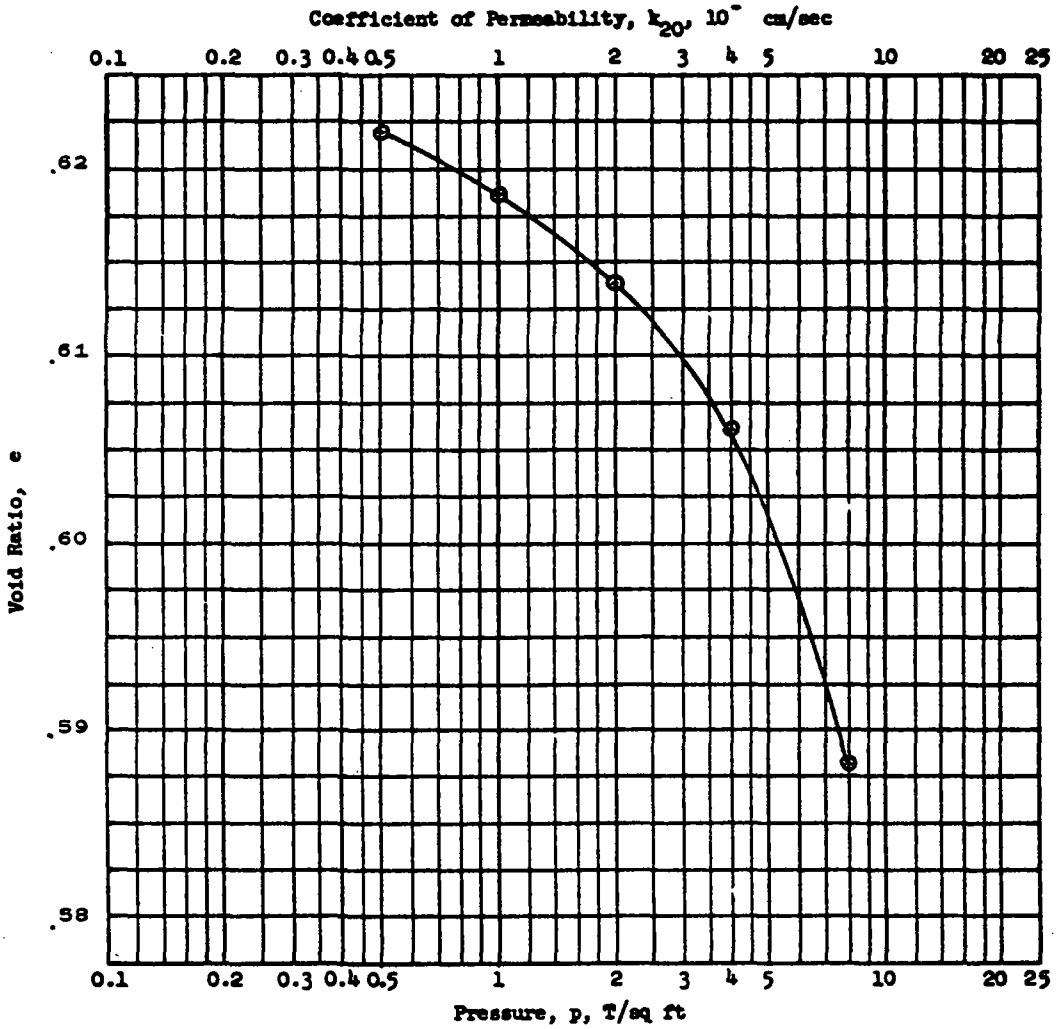
Job No. 409-J-078

Area

Boring No. 7

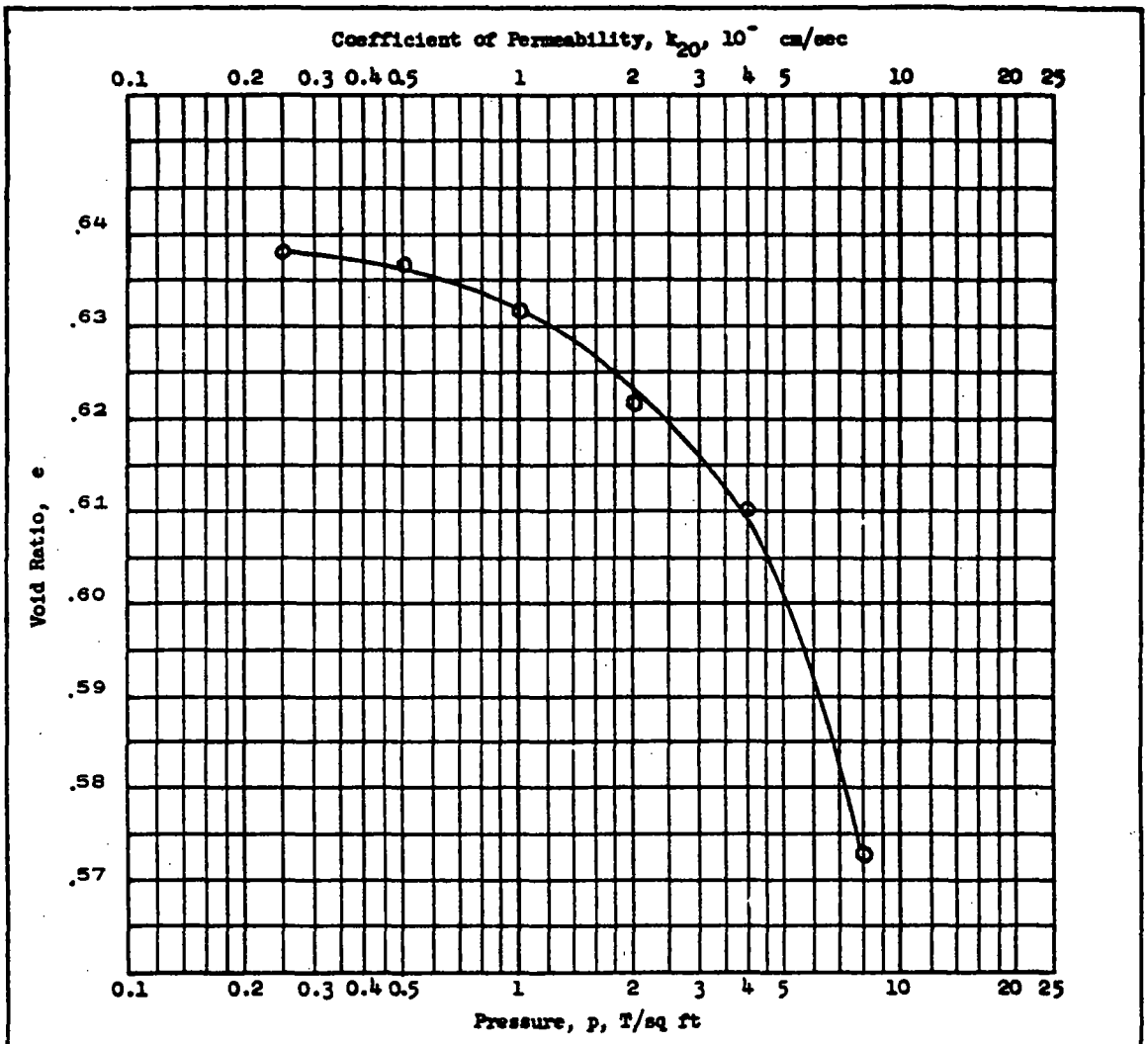
Date

KANSAS CITY TESTING LABORATORY



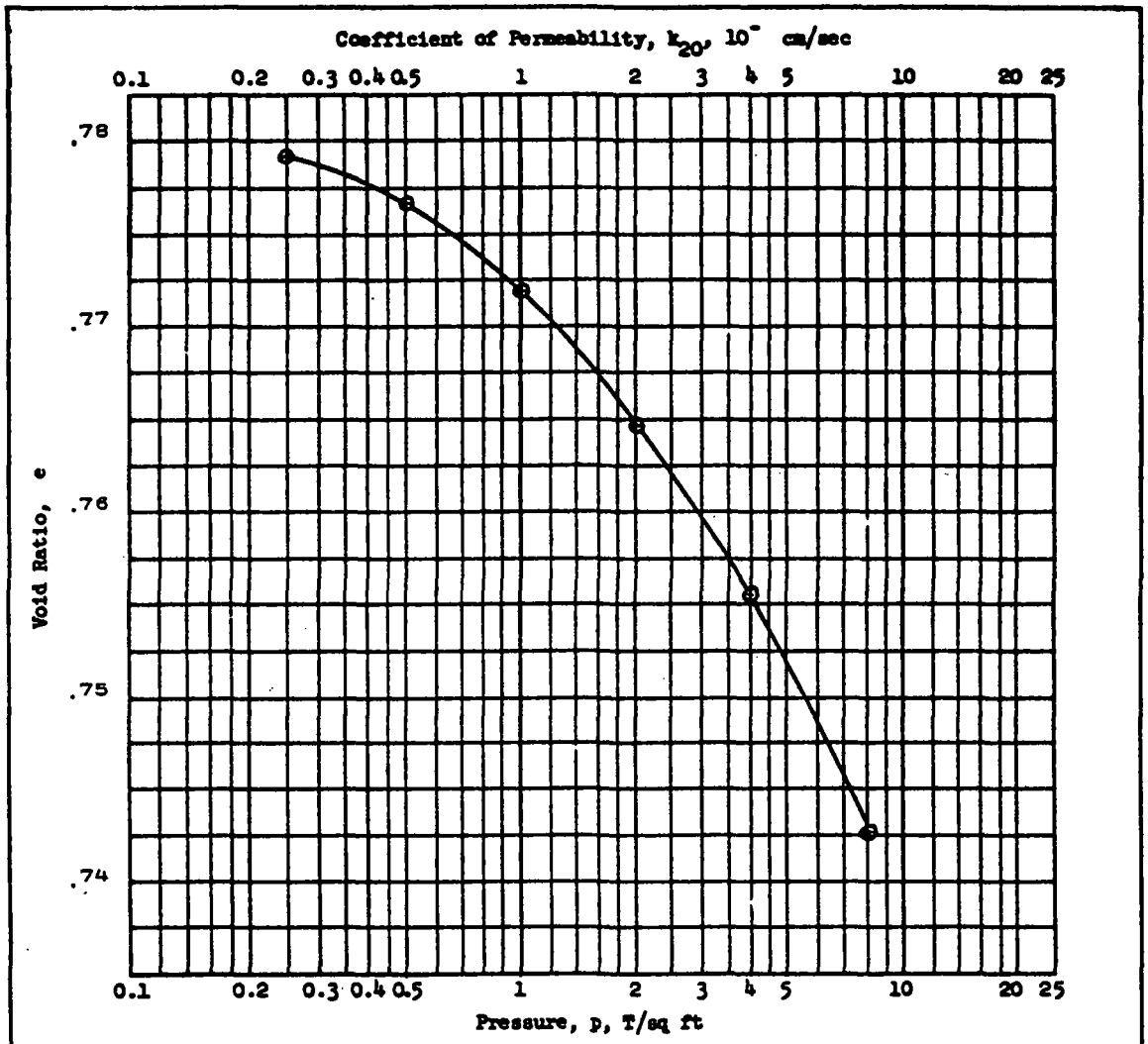
Type of Specimen UNDISTURBED		Before Test		After Test	
Diam 2.500 in.	Ht 1.002 in.	Water Content, w_o	21.2 %	w_f	21.8 %
Overburden Pressure, p_o T/sq ft		Void Ratio, e_o	0.623	e_f	0.547
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	91.9 %	S_f	107.5 %
Compression Index, C_c		Dry Density, γ_d	103.8 lb/ft^3		
Classification		k_{20} at e_o = 1.87	$\times 10^{-8}$ cm/sec at 2.0 TSF		
LL	G_s 2.7 ASSUMED	Project ROSECHEM		Job No. 409-J-078	
PL	D_{10}	BURNS AND MCDONNELL			
Remarks GRAY MOTTLED YELLOW		Area			
AND DARK BROWN SHALY CLAY		Boring No. MW-105		Sample No. ST-1	
WITH IRON DEPOSITS AND SMALL		Depth El 6.0-8.0 ft		Date	
GRAVEL		CONSOLIDATION TEST REPORT			

KANSAS CITY TESTING LABORATORY



Type of Specimen UNDISTURBED		Before Test		After Test	
Diam 2.500 in.	Ht 0.986 in.	Water Content, w_o	23.8 %	w_f	24.5 %
Overburden Pressure, Po T/sq ft		Void Ratio, e_o	0.639	e_f	0.524
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	99.7 %	S_f	126.1 %
Compression Index, C_c		Dry Density, γ_d	102.5 lb/ft^3		
Classification		k_{20} at e_o = 2.52	$\times 10^{-8}$ cm/sec	at 2.0 TSF	
LL	G_s 2.7 ASSUMED	Project ROSECHEM		Job No. 409-J-078	
PL	D_{10}	BURNS AND MCDONNELL			
Remarks YELLOW-BROWN MOTTLED		Area			
DARK BROWN AND GRAY SHALY CLAY		Boring No. MW-106		Sample No. ST-1	
WITH SMALL GRAVEL		Depth El 8.0-9.5 ft		Date	
		CONSOLIDATION TEST REPORT			

KANSAS CITY TESTING LABORATORY



Type of Specimen UNDISTURBED		Before Test		After Test	
Diam 2.500 in.	Ht 0.992 in.	Water Content, w_o	27.5 %	w_f	27.3 %
Overburden Pressure, Po T/sq ft		Void Ratio, e_o	0.780	e_f	0.693
Preconsol. Pressure, p_c T/sq ft		Saturation, S_o	95.1 %	S_f	106.3 %
Compression Index, C_c		Dry Density, γ_d	94.6 lb/ft^3		
Classification		k_{20} at e_o = 2.97	x 10^{-8} cm/sec AT 2.0 TSF		
LL	G_s 2.7 ASSUMED	Project ROSECHEM		Job No. 409-J-078	
PL	D_{10}	BURNS AND MCDONNELL			
Remarks LIGHT GRAY MOTTLED RUST		Area			
SHALY CLAY WITH IRON DEPOSITS		Boring No. MW-110		Sample No. ST-1	
AND SANDSTONE FRAGMENTS		Depth El 8.0-10.0 ft		Date	
		CONSOLIDATION TEST REPORT			

APPENDIX F - DRILLING LOGS AND WELL CONSTRUCTION RECORDS FOR PREVIOUSLY INSTALLED MONITORING WELLS

JOHN MATHES & ASSOCIATES, INC.

GEOLOGIC LOG FOR BORING NO. TB1/SB25/MW-101

DATE 6/10-12/87 PROJECT NO. 12872844

PROJECT Rose Chemical JMA CONTRACT NO. N/A

LOCATION West of South Warehouse L.S. ELEV. 94.5'

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL (ft)	SAMPLE TYPE	SAMPLE RECOVERY	SAMPLE DESCRIPTIONS	Qp	REMARKS
	1	0.0	CTS		0-4.5' dark brown silty sandy clay; trace gravel; rooted; strace Fe stains; CL	3.5	1-TB1-1-Chemical Analysis
	2	4.5	CTS	2.9'		2.3	2-TB1-2 Chemical Analysis
5		4.5			4.5-9.5' gray brown silty sandy clay w/gravel; Fe stains; charcoal material from 6.0' down; CL	1.5	
	3	9.5	CTS	4.5'		1.25	
						.8	3-Physical Test-TB1-P1
10		9.5		5.0'	9.5-14.5' S.A.A. -heavily oxidized zone 12.5-13'; increase gravel to 13'		
	4	14.5	CTS		13.0-14.5' SHALE-gray green; dry, friable	2.2	4-TB1-P2-Physical Test
						3.0	-set 4" PVC casing @ 14.5'
15		14.5			14.5-15.5' gray green shale w/L.S. Fragments	4.5+	
		18.2	NW	3.25'	15.5-18.2' gray green L.S. w/shale inclusions; highly fractured		NX Wireline coring 14.5-48.2'
					18.2'-dark gray shale		
20				9.0'			
			NW				
25							
		28.2			26.5'-gray green shaley LIMESTONE; fractured w/shale filled voids		26.4'-Rob barrel due to swelling shale
		28.2			28.2'-green gray shaley L.S.		
30			NW	10.0'	30'-light gray L.S. w/thin gray shale partings		
35					34'-Interbedded shale and L.S.; shale weathered, L.S. very slightly weathered		

DRILLING METHOD NX Wireline/4½" Hollow Stemmed Augers

DATE DRILLED 6/10-12/87

DRILLED BY C. Hebel

LOGGED BY T. Fuhrhop

PIEZOMETER Yes

WI SERIAL # N/A

GROUNDWATER LEVELS

____ Encountered at _____ feet

____ Hours after completion _____ feet

____ " after completion _____ feet

____ " after completion _____ feet

GEOLOGIST'S SIGNATURE _____

JOHN MATHES & ASSOCIATES, INC.

GEOLOGIC LOG FOR BORING NO. TB1/SB25/MW-101

DATE 6/10-12/87 PROJECT NO. 12872844

PROJECT Rose Chemical JMA CONTRACT NO. N/A

LOCATION West of South Warehouse L.S. ELEV. 94.5'

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL (ft)	SAMPLE TYPE	SAMPLE RECOVERY	SAMPLE DESCRIPTIONS	Qp	REMARKS
		38.2			37.2'-gray sandy L.S.-sandstone with thin gray shale partings		
40		38.2			38.2'-light gray shaley L.S. 39.25'-dark gray shale; slightly weathered at 47'		
				10.0'			
			NW				
45							
		48.2			TOB @ 48.2'		
50							Hole reamed to 50' for geophysical testing
55							
60							
65							
70							

DRILLING METHOD NX Wireline / 4¼" Hollow-stemmed augers

DATE DRILLED 6/10-12/87

DRILLED BY C. Hebel

LOGGED BY T. Fuhrhop

PIEZOMETER Yes

WI SERIAL # NA

GROUNDWATER LEVELS

___ Encountered at ___ feet

___ Hours after completion ___ feet

___ " after completion ___ feet

___ " after completion ___ feet

GEOLOGIST'S SIGNATURE _____

JOHN MATHES & ASSOCIATES, INC.

GEOLOGIC LOG FOR BORING NO. TB2/SB17/MW-102

DATE 6/14-15/87 PROJECT NO. 12872844

PROJECT Rose Chemical JMA CONTRACT NO. N/A

LOCATION West of Main Warehouse L.S. ELEV. 106.1'

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL (ft)	SAMPLE TYPE	SAMPLE RECOVERY	SAMPLE DESCRIPTIONS	Qp	REMARKS
	1	0.0			0-1'-gravel fill		1-TB2-1-Chemical Analysis
	2		CTS	4.5'	1-1.5'-CL gray brown; mottled; Fe stains; trace gravel; stiff; black charcoal material near bottom		2-TB2-2-Chemical Analysis
		4.5					
-5-	3		CTS	3.5'	4.5-9.5' gray brown shale; very weathered; trace gravel; zones of Fe staining		3-Physical testing TB2-P1
	4	9.5	CTS				4-TB2-4-Chemical Analysis
-10-	5	9.5	CTS	2.5'	9.5-12.0' gray shale w/interbedded clay shale zones (0.2-0.3')		5-TB2-5-Chemical Analysis
		12.0					4" PVC casing set @ 12.0'
		12.0			12.0-18.5' dark gray shale thin bedded		NX Wireline coring 12.0-18.5'
-15-			NW	6.5'			
		18.5					
		18.5			18.5-19.1' dark gray shale 19.1-19.9' coal 19.9-25.9' gray clay-shale; weathered		
-20-			NW	9.0'			
-25-					25.9-27.7'-S.A.A. w/interbedded hard gray shale-thin beds		
		28.5			27.7-28.5' interbedded gray shale and light gray L.S.		
		28.5			28.5 - 34.0' dark gray weathered shale w/some interbedded L.S. layers		
-30-							
			NW	6.5'			
-35-					34.0-36.1'-light gray L.S. -no weathering-some vugs		

DRILLING METHOD NX Wireline /4¼" Hollow Stemmed Augers

DATE DRILLED 6/14-15/87

DRILLED BY C. Hebel

LOGGED BY T. Fuhrhop

PIEZOMETER Yes

WI SERIAL # N/A

GROUNDWATER LEVELS

____ Encountered at ____ feet

____ Hours after completion ____ feet

____ " after completion ____ feet

____ " after completion ____ feet

GEOLOGIST'S SIGNATURE _____

JOHN MATHES & ASSOCIATES, INC.

GEOLOGIC LOG FOR BORING NO. TB2/SB17/MW-102

DATE 6/14-15/87 PROJECT NO. 12872844

PROJECT Rose Chemical JMA CONTRACT NO. N/A

LOCATION West of Main Warehouse L.S. ELEV. 106.1'

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL (ft)	SAMPLE TYPE	SAMPLE RECOVERY	SAMPLE DESCRIPTIONS	Qp	REMARKS
					36.1-38.5' dark gray shale-some weathering-friable		
		38.5			38.5-43.3' dark gray shale some weathering-a few thin interbedded L.S. layers		
40		38.5					
			NW	9.6'	43.3-48.5'-light gray L.S.		Signs of weathering 43.3-44.8'
45							
		48.5			TOB @ 48.5'		
50							
55							
60							
65							
70							

DRILLING METHOD NX Wireline/14¼" Hollow Stemmed Augers

DATE DRILLED 6/14-15/87

DRILLED BY C. Hebel

LOGGED BY T. Fuhrhop

PIEZOMETER Yes

WI SERIAL # N/A

GROUNDWATER LEVELS

___ Encountered at ___ feet

___ Hours after completion ___ feet

___ " after completion ___ feet

___ " after completion ___ feet

GEOLOGIST'S SIGNATURE ___

JOHN MATHES & ASSOCIATES, INC.

GEOLOGIC LOG FOR BORING NO. TB3/SB20/MW-103

DATE 6/9-10/87 PROJECT NO. 12872844

PROJECT Rose Chemical JMA CONTRACT NO. N/A

LOCATION South of Stormwater Retention Pond L.S. ELEV. 88.8'

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL (ft)	SAMPLE TYPE	SAMPLE RECOVERY	SAMPLE DESCRIPTIONS	Qp	REMARKS
	1	0.0			0-4.5' gray brown silty sandy clay w/trace gravel; Fe stains; rooted; CL		1-TB3-1-Chemical Analysis
	2		CTS	4.5'		3.75	2-TB3-2-Chemical Analysis
	3	4.5			4.5-9.5' gray brown silty clay; trace sand & gravel- more sand w/depth; Fe stains; black charcoal material visible @ 8.0'; CL		3-TB3-P1-Physical Sample
5		4.5				2.5	
	4		CTS	5.0'		2.25	4-TB3-P2-Physical Sample
		9.5				2.75	
10		9.5			S.A.A.	1.75	
			CTS	5.0'			
		14.5			13.5' yellow brown-dark gray friable shale	2.5	
						4.25	
15		14.5	CTS	1.5'	14.5-17.5' dark gray shale-dry; very friable-dusty		
		17.5					4" PVC casing set to 17.5'
		17.5	CTS	.5	17.5-18.2' gray shale-L.S. fragments		
		18.2			18.2-20.3' dark gray shale		
20		18.2					
				9.75'	20.3-22.0' interbedded shale & light gray L.S.		
			NW		22.0-27.9' gray L.S.; few fractures; few shale stingers		NX Wireline coring 18.2-47.7'
25							
		28.2			27.9-28.2' interbedded L.S. & dark gray shale		
		28.2			28.2-29.2' interbedded L.S. & shale; high percentage of pyrite in shale		
30					29.2-31.3' dark gray shale; some L.S. nodules		
			NW		31.3-33.9' gray green sandstone w/shale lenses		
				9.5'	33.9-38.2' sandy shale; dark gray; sandy partings fine layering		
35							

DRILLING METHOD NX Wireline/4¼" Hollow Stemmed Augers

DATE DRILLED 6/9-10/87

DRILLED BY C. Hebel

LOGGED BY T. Fuhrhop

PIEZOMETER Yes

WI SERIAL # N/A

GROUNDWATER LEVELS

___ Encountered at ___ feet

___ Hours after completion ___ feet

___ " after completion ___ feet

___ " after completion ___ feet

GEOLOGIST'S SIGNATURE _____

JOHN MATHES & ASSOCIATES, INC.

GEOLOGIC LOG FOR BORING NO. TB3/SB20/MW-103

DATE 6/9-10/87 PROJECT NO. 12872844

PROJECT Rose Chemical JMA CONTRACT NO. N/A

LOCATION South of Stormwater Retention Pond L.S. ELEV. 88.8'

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL (ft)	SAMPLE TYPE	SAMPLE RECOVERY	SAMPLE DESCRIPTIONS	Qp	REMARKS
		38.2					
40		38.2	NW	10.0	38.2-39.9' dark gray shale no fractures @ weathering 39.9-42.3' dark gray shale highly weathered 42.3-47.7' L.S.-weathered; brown gray; vugs; some thin shale partings-few fractures		.5' missing from 28.2'-38.2' run was recovered in next run
45		47.7			TOB 47.7'		
50							
55							
60							
65							
70							

DRILLING METHOD NX Wireline/4¼" Hollow-Stemmed Augers

DATE DRILLED 6/9-10/87

DRILLED BY C. Hebel

LOGGED BY T. Fuhrhop

PIEZOMETER Yes

WI. SERIAL # N/A

GROUNDWATER LEVELS

___ Encountered at ___ feet

___ Hours after completion ___ feet

___ " after completion ___ feet

___ " after completion ___ feet

GEOLOGIST'S SIGNATURE _____

JOHN MATHES & ASSOCIATES, INC.

GEOLOGIC LOG FOR BORING NO. MW201

DATE 6-24-87 PROJECT NO. 12872844

PROJECT Rose Chemical JMA CONTRACT NO. N/A

LOCATION West of south Warehouse L.S. ELEV. 95.2'

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL (ft)	SAMPLE TYPE	SAMPLE RECOVERY	SAMPLE DESCRIPTIONS	Qp	REMARKS
					0.0-13.2'-No Samples-drilled w/augers & centerplug. See TBI/SB25 for geologic description.		
5							
10							
					13.2'-Auger refusal TOB @ 13.2'		
15							
20							
25							
30							
35							

DRILLING METHOD 4¼" Hollow Stemmed Augers
DATE DRILLED 6-24-87
DRILLED BY C. Hebel
LOGGED BY T. Fuhrhop
PIEZOMETER Yes
WI SERIAL # N/A

GROUNDWATER LEVELS

____ Encountered at ____ feet
____ Hours after completion ____ feet
____ " after completion ____ feet
____ " after completion ____ feet

GEOLOGIST'S SIGNATURE _____

JOHN MATHES & ASSOCIATES, INC.

GEOLOGIC LOG FOR BORING NO. MW202

DATE 6-27-87 PROJECT NO. 12872844

PROJECT Rose Chemical JMA CONTRACT NO. N/A

LOCATION West of Main Warehouse L.S. ELEV. 106.1'

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL (ft)	SAMPLE TYPE	SAMPLE RECOVERY	SAMPLE DESCRIPTIONS	Qp	REMARKS
					Drilled w/augers & centerplug; No samples taken; See TB2/SB17 log for geologic description.		
5							
10							
15							
20					Auger refusal @ 20.5' TOB @ 20.5'		
25							
30							
35							

DRILLING METHOD 4¼" Hollow Stemmed Augers

DATE DRILLED 6-27-87

DRILLED BY C. Hebel

LOGGED BY T. Fuhrhop

PIEZOMETER Yes

WI SERIAL # N/A

GROUNDWATER LEVELS

___ Encountered at ___ feet

___ Hours after completion ___ feet

___ " after completion ___ feet

___ " after completion ___ feet

GEOLOGIST'S SIGNATURE _____

JOHN MATHES & ASSOCIATES, INC.

GEOLOGIC LOG FOR BORING NO. MW-203

DATE 6-25-87 PROJECT NO. 12872844

PROJECT Rose Chemical JMA CONTRACT NO. N/A

LOCATION South of Stormwater Retention Pond L.S. ELEV. 89.1'

DEPTH (ft)	SAMPLE NUMBER	SAMPLE INTERVAL (ft)	SAMPLE TYPE	SAMPLE RECOVERY (in)	SAMPLE DESCRIPTIONS	Qp	REMARKS
					0-18.8' drilled w/augers & centerplug. No samples taken. See TB3/SB20 for geologic description.		
5					Driller's Note: 11.5'-more difficult drilling-TOR-fractured L.S. ? 14.0' top of shale; Cutting very slow @ 19.0'; Decided to set well.		
10							
15							
					TOB @ 18.8'		
20							
25							
30							
35							

DRILLING METHOD 4¼ Hollow Stemmed Augers

DATE DRILLED 6-25-87

DRILLED BY C. Hebel

LOGGED BY T. Fuhrhop

PIEZOMETER Yes

WI SERIAL # N/A

GROUNDWATER LEVELS

____ Encountered at ____ feet

____ Hours after completion ____ feet

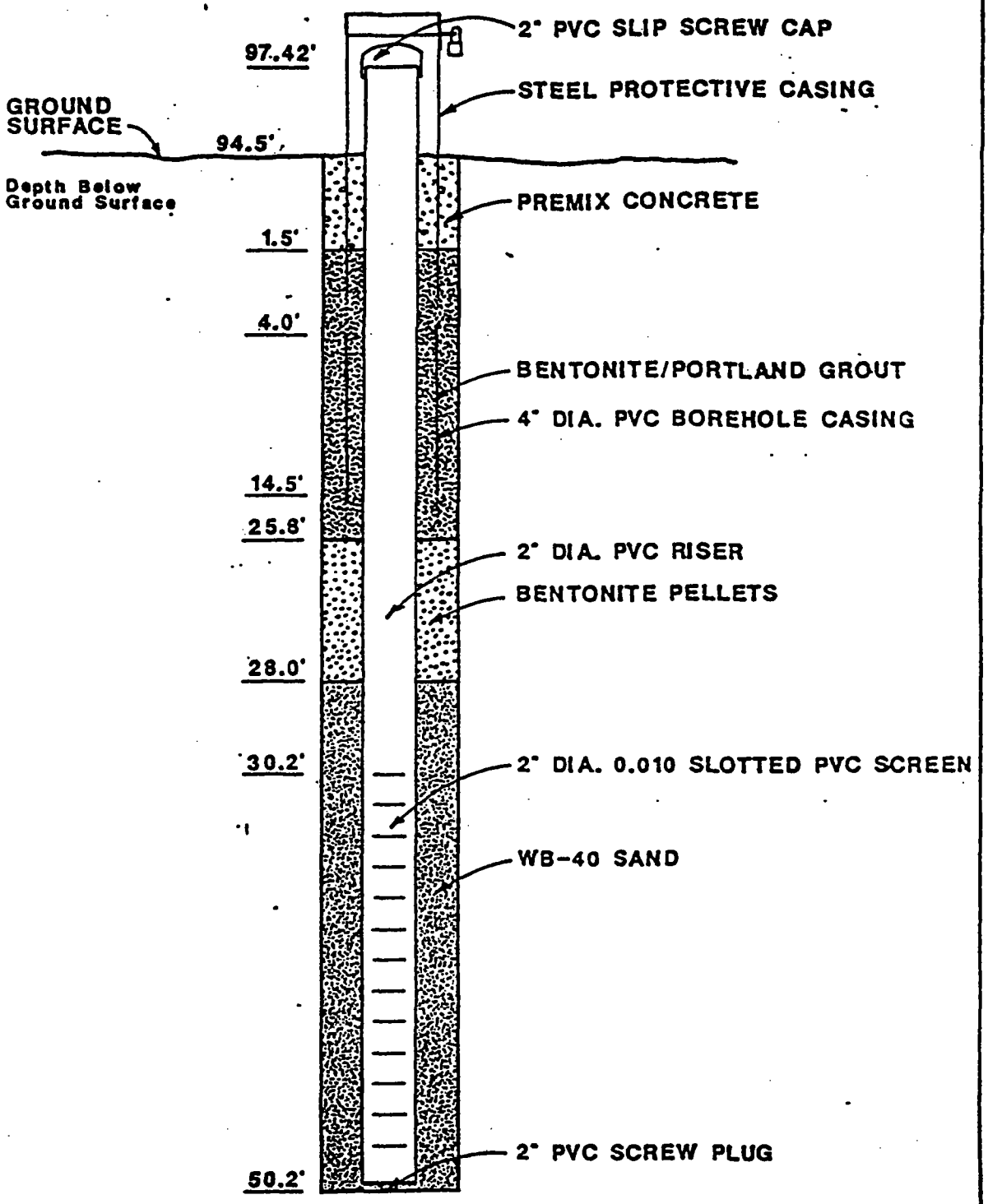
____ " after completion ____ feet

____ " after completion ____ feet

GEOLOGIST'S SIGNATURE _____

JMA PROJECT NO. 12872844 DRILLER HEBEL/ELLIS

MONITORING WELL NO. MW-101 DATE INSTALLED 6/26/87



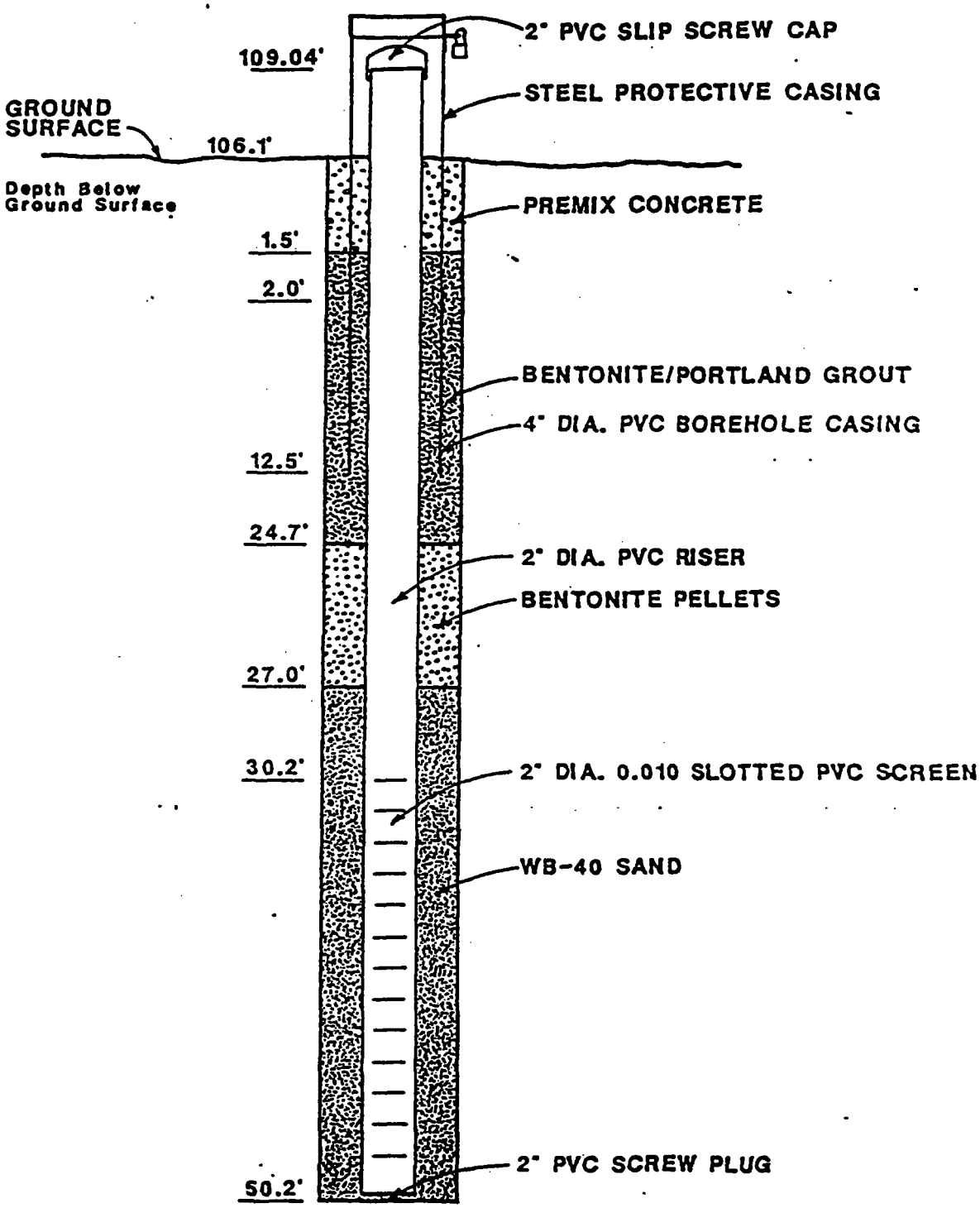
NOT TO SCALE

BOREHOLE DIAMETER 8 1/4" SANDPACK 22.2'

SCREEN LENGTH 20.0' RISER LENGTH 33.1'

JMA PROJECT NO. 12872844 DRILLER HEBEL/ELLIS

MONITORING WELL NO. MW-102 DATE INSTALLED 6/26/87



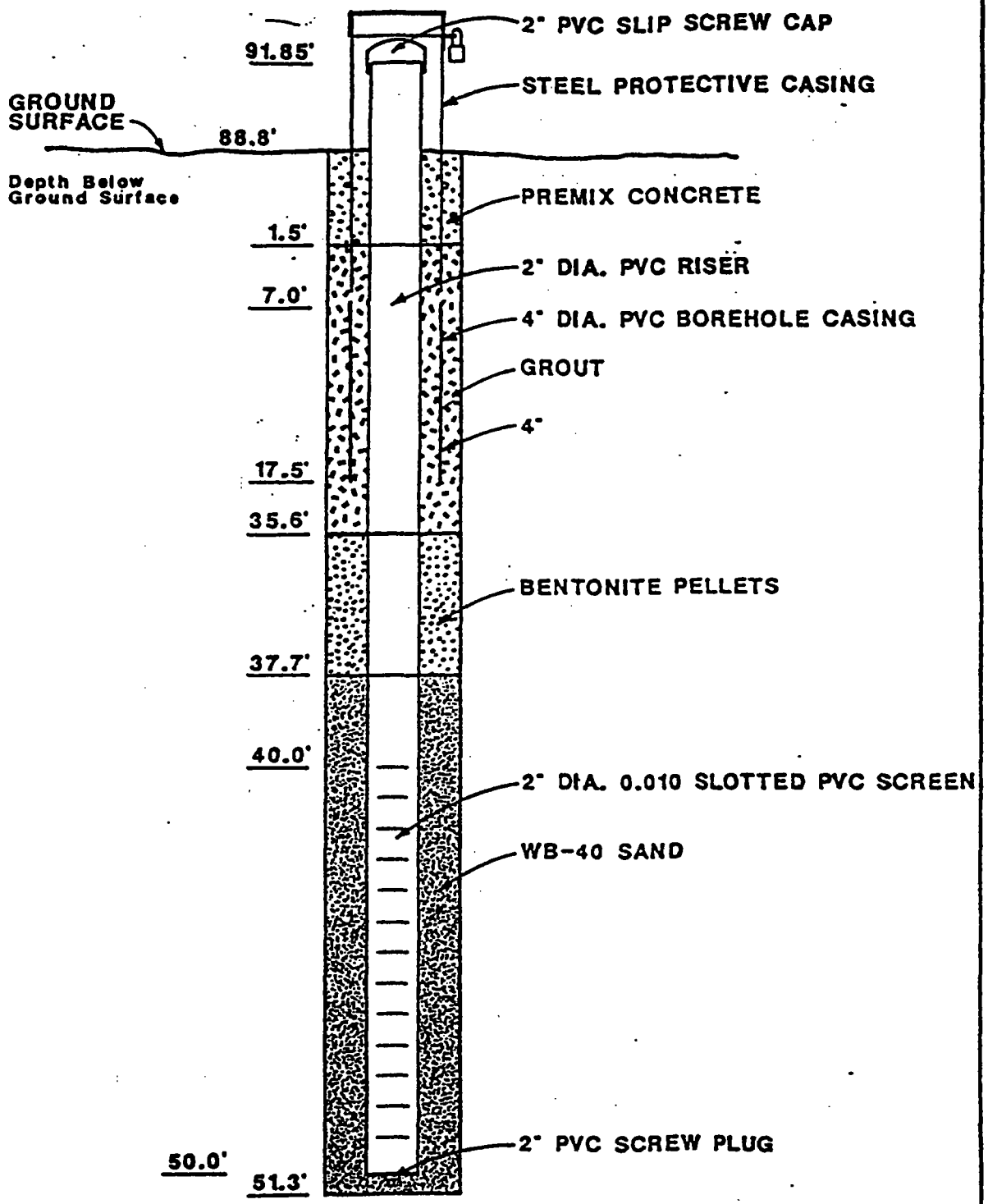
NOT TO SCALE

BOREHOLE DIAMETER 8 1/4" SANDPACK 23.2'

SCREEN LENGTH 20.0' RISER LENGTH 33.1'

JMA PROJECT NO. 12872844 DRILLER HEBEL/ELLIS

MONITORING WELL NO. MW-103 DATE INSTALLED 6/25/87



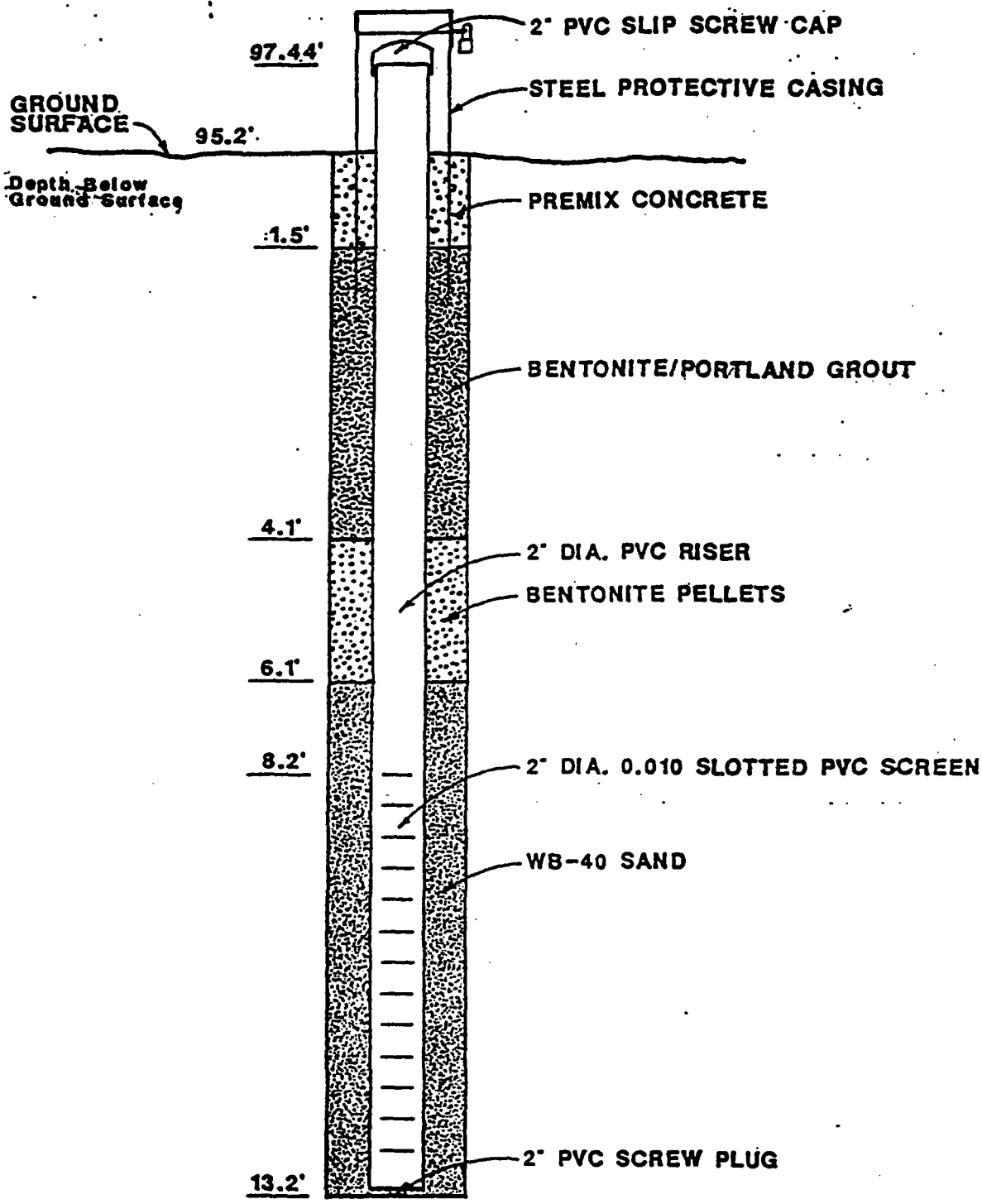
NOT TO SCALE

BOREHOLE DIAMETER 8 1/4" SANDPACK 13.6'

SCREEN LENGTH 10.0' RISER LENGTH 43.1'

JMA PROJECT NO. 12872844 DRILLER HEBEL/ELLIS

MONITORING WELL NO. MW-201 DATE INSTALLED 6/24/87



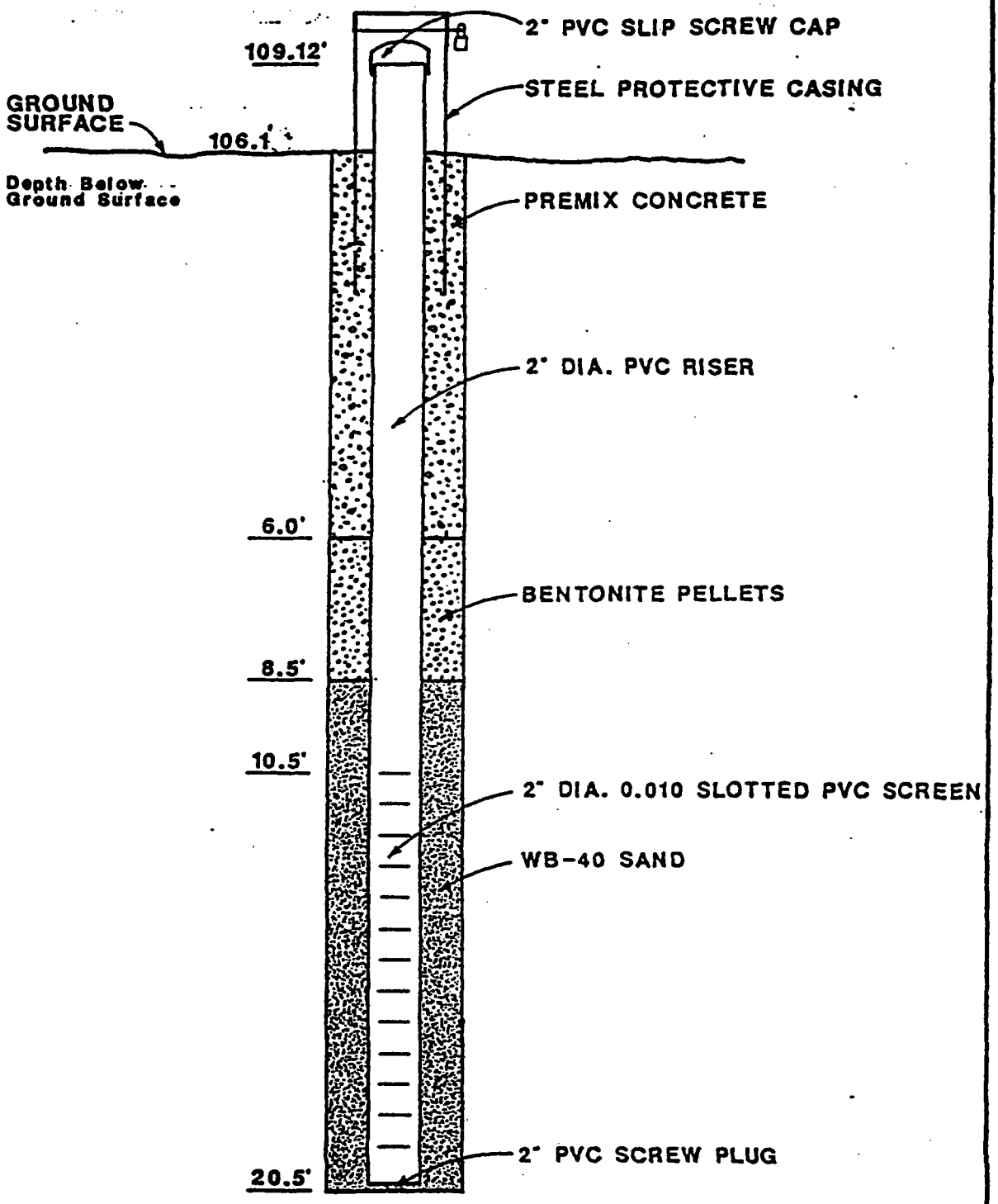
NOT TO SCALE

BOREHOLE DIAMETER 8 1/4" SANDPACK 7.1'

SCREEN LENGTH 5.0' RISER LENGTH 10.4'

JMA PROJECT NO. 12872844 DRILLER HEBEL/ELLIS

MONITORING WELL NO. MW-202 DATE INSTALLED 6/27/87



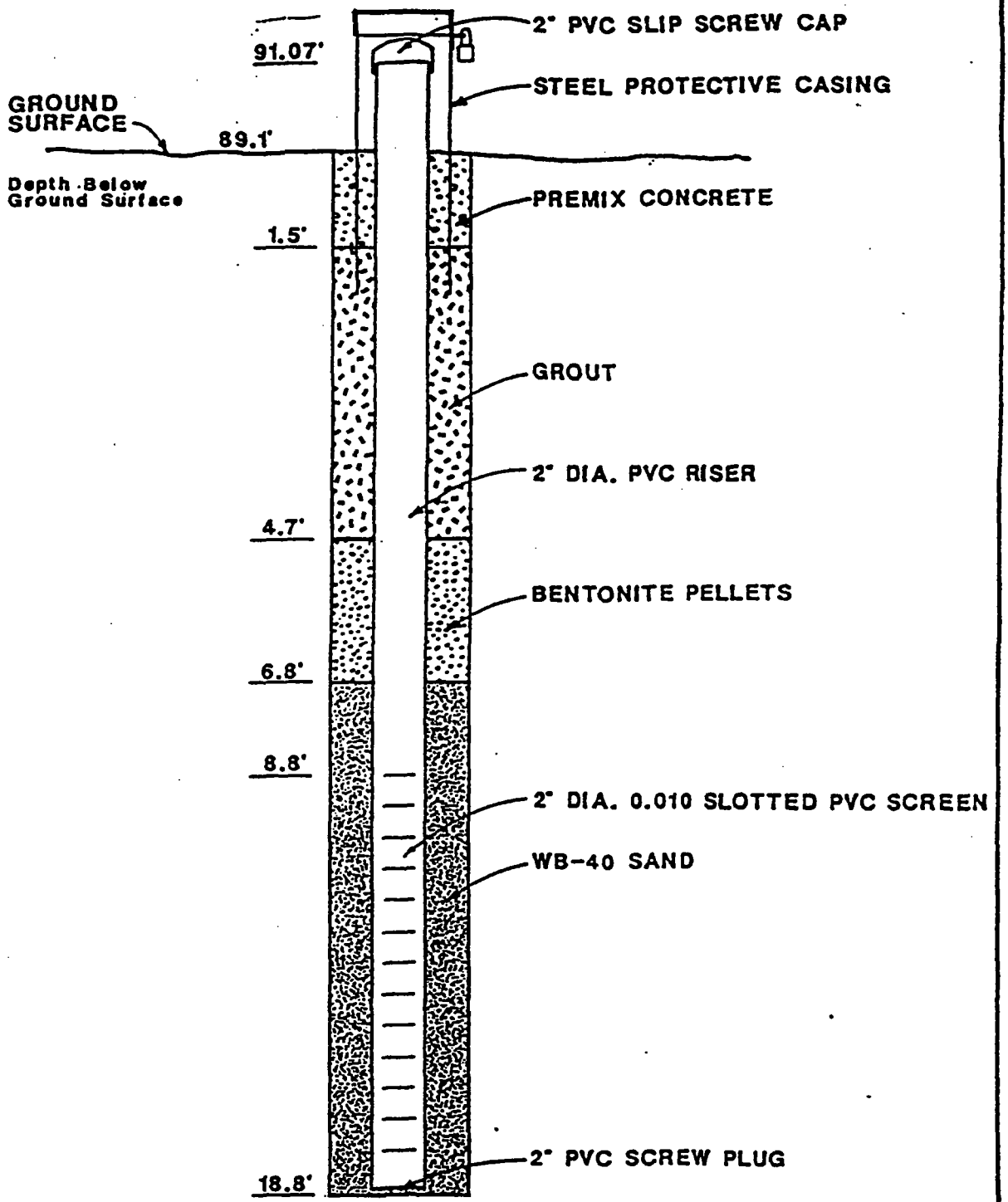
NOT TO SCALE

BOREHOLE DIAMETER 8 1/4" SANDPACK 12.0'

SCREEN LENGTH 10.0' RISER LENGTH 13.5'

JMA PROJECT NO. 12872844 DRILLER HEBEL/ELLIS

MONITORING WELL NO. MW-203 DATE INSTALLED 6/25/87



NOT TO SCALE

BOREHOLE DIAMETER 8 1/4" SANDPACK 12.0'

SCREEN LENGTH 10.0' RISER LENGTH 10.8'